IMPORTANT INVERTEBRATE AREA PROFILE

West Cornwall & The Lizard

Left: Pentreath Beach, The Lizard © Lucia Chmurova. Right: Southern Mesh-weaver (*Lathys stigmatisata*) © Emanuele Santarelli (CC-BY-SA)

The West Cornwall and The Lizard Important Invertebrate Area (IIA) falls largely within the boundaries of the Cornwall National Landscape. The largest section of the IIA can be found on the Lizard – a peninsula at the southernmost point of mainland Britain and with a rich geological, cultural and natural history. The area is dominated by an undulating exposed heathland plateau cut by narrow river valleys with broadleaved woodland. Farming is common around the plateau, with a mixture of agriculturally improved grazing, rough grassland, and large-scale vegetable and arable production. Bursts of colour pop out from commercial daffodil farms and the typical flower-rich Cornish hedgebanks intersecting the landscape. The surrounding coastline is geologically complex with steep-sided coves, dramatic cliffs, and small rocky islands – a coastline famous for its ruggedness as well as popular sandy beaches.

On the plateau, the poorly draining multi-coloured serpentinite and gabbro rocks give rise to internationally important dry and wet lowland heathland. Much of this is part of the Lizard National Nature Reserve (NNR)/Special Area of Conservation (SAC). Here, the extensive Goonhilly Downs Site of Special Scientific Interest (SSSI), West Lizard SSSI and East Lizard Heathland SSSI support populations of the European Vulnerable Moss Carder Bee (*Bombus muscorum*) and Marsh Fritillary (*Euphydryas aurinia*), as well as an assemblage of rare beetles and other flying insects including the dung beetle *Onthophagus nuchicornis*, Western Thyme Plume (*Merrifieldia tridactyla*), and the long-legged fly *Syntormon mikii*. The wet heathland and grassland features here support many aquatic and semi-aquatic beetles like the predacious diving beetle *Graptodytes flavipes* and the crawling water beetle *Haliplus variegatus.* The area around the Predannack Airfield is one of only a few sites in Cornwall with records of Tormentil Nomad Bee

(*Nomada roberjeotiana*), a kleptoparasite of Tormentil Mining Bee (*Andrena tarsata*). Most of the remaining Lizard heathland is currently managed for conservation by low intensity grazing.

The whole of the Lizard has an almost unbroken fringe of species-rich coastal vegetation supporting a mosaic of grassland, heath, scrub and cliff-ledge communities. The IIA covers almost the full extent of this stretch between Porthleven in the west and Porthoustock in the east. The maritime cliffs and slopes at Porthleven and Loe Bar beaches support species like Buff-banded Mining Bee (*Andrena simillima*), and the weevils *Ceutorhynchus parvulus* and *Cathormiocerus attaphilus*. Sparsely vegetated dry ground and shingle seepages provide habitat for the ground beetles *Philorhizus vectensis* and *Lionychus quadrillum*. Rockface Beetle (*Ochthebius poweri*), a highly specialised insect of seepages on vertical coastal cliff faces, can be found around Gunwalloe and Poldhu Coves. At Predannack Head, the largest population of Marsh Fritillary on the Lizard can be found alongside other rare moths and spiders like the miner of Saw-wort plants, Cornish Flat-body (*Agonopterix kuznetzovi*), Cornish White-barred (*Aproaerema suecicella*), the White-moustached Jumping Spider (*Euophrys herbigrada*), and Swiss Sac-spider (*Porrhoclubiona genevensis*).

Further south on the coast, an especially noteworthy area is around Kynance Cove where the clifftop grassland and dwarf heathland habitat mosaics support a huge diversity of invertebrates, particularly spiders, moths and beetles. Spiders include the Endangered Blackwall's Crablet (*Cozyptila blackwalli*), Southern Mesh-weaver (*Lathys stigmatisata*), Golden Lantern-spider (*Agroeca cuprea*), Pallid Hair-head (*Acartauchenius scurrilis*) and Western Ground Spider (*Gnaphosa occidentalis*); the moths include Twilight Neb (*Eulamprotes immaculatella*), Buff Groundling (*Prolita solutella*), and Meadow-sweet Pygmy (*Stigmella filipendulae*); the beetles include Sheep's-bit Weevil (*Cleopomiarus micros*). The remainder of the coast contains similar coastal habitat with the addition of high-quality cliffs and slips with soft geology at Coverack, supporting mining bees such as Hairy-saddled Colletes (*Colletes fodiens*). Other moths in the area include Western Groundling (*Bryotropha dryadella*) and Thyme-associated Cliff Case-barer (*Coleophora serpylletorum*). Numerous historical mining features are scattered throughout heathland as well as on the coast in this IIA. Of special note are the disused quarries at St Keverne and Cadgwith, which provide scree and dry rocky habitat features that are especially important for rare spiders.

Above the Lizard, lining the Helford River and its creeks, sits one of the largest stretches of ancient woodland in West Cornwall. This little-accessible wet and dry woodland habitat is important for beetles and flies including the weevil *Anchonidium unguiculare* and the winter craneflies *Trichocera rufescens* and Great Long-tailed Winter Gnat (*T. major*). Saltmarsh habitat around Devoran is important for brackish specialists including Grey Blite Case-bearer (*Coleophora deviella*), and the provisionally Endangered reed-associated flies *Cryptonevra consimilis* and Cigarillo Gall-fly (*Lipara similis*). The area around Killigerran Head at the tip of the Roseland Peninsula forms the easternmost part of this IIA and supports similar species to those found around Kynance Cove. Additionally, the areas around the southern coast across the IIA are also important for Shore Crevice Bug (*Aepophilus bonnairei*) and several rare centipedes including *Stigmatogaster souletinus*, *Hydroschendyla submarina* and *Eurygeophilus pinguis*.

On the north coast, the IIA overlaps the coastal stretch of Godrevy Head to St Agnes SSSI/SAC. Maritime slopes and cliffs together with the surrounding lowland heathland, especially around Porthtowan, support a diverse invertebrate assemblage including the weevil *Cathormiocerus maritimus*, Cornish Midget (*Phyllonorycter staintoniella*), Cornish Detritus Moth (*Infurcitinea captans*), and the Endangered Nose Gallows-spider (*Lasaeola prona*). The presence of old

Western Thyme Plume (*Merrifieldia tridactyla*) © Heidrun Melzer

mineshafts on the coast here, especially around Porthtowan and St Agnes, causes surface water to quickly drain down the shafts, creating an unusually arid scree environment, which is important for rare spiders as well as ground-nesting bees and wasps. The nearby area of the Red River and its surrounding wetland and woodland habitats is of high importance to invertebrates and supports the jumping ground bug *Pachycoleus waltli* and the ant-nest specialist, Limestone Ant Fly (*Microdon mutabilis*). Lastly, the Portreath Stream with the nearby Nance Wood SSSI support a good population of Brown Diving Beetle (*Agabus brunneus*).

Reasons for selection

The West Cornwall and the Lizard IIA supports at least 62 qualifying IIA species of conservation concern. The area supports the following species which are endemic, threatened on a European scale or Endangered on a national scale:

- Endemic British Cave Shrimp (*Niphargus glenniei*)
- European Vulnerable Hairy-saddled Colletes (*Colletes fodiens*)
- European Vulnerable Moss Carder Bee (*Bombus muscorum*)
- Endangered Blackwall's Crablet (*Cozyptila blackwalli*)
- Endangered Nose Gallows-spider (*Lasaeola prona*)
- Provisionally Endangered grass fly *Cryptonevra consimilis*
- Provisionally Endangered Cigarillo Gall-fly (*Lipara similis*)

Buff-banded Mining Bee (*Andrena simillima*) © Steven Falk

The IIA also supports an assemblage of nationally Vulnerable species, including the Brown Diving Beetle, the crawling water beetle *Haliplus variegatus*, the flea beetle *Ochrosis ventralis*, the dung beetle *Onthophagus nuchicornis,* Marsh Fritillary, the sausage millipede *Chordeuma sylvestre*, White-moustached Jumping Spider, Southern Mesh-weaver, and Grass Money Spider.

Nationally, species like Cornish Detritus Moth, Cornish White-barred, Cornish Midget, and the centipede *Stigmatogaster souletinus* can only be found in and around this IIA. This IIA is also a stronghold for many other species including Sheep's-bit Weevil, Cornish Flat-body, Western Thyme Plume, Cliff Case-bearer, and White-moustached Jumping Spider, which are found in only one or a handful of other counties outside of Cornwall. Western Ground Spider (*Gnaphosa occidentalis*) can only be found in Cornwall, its core population is found within this IIA.

Additionally, this IIA is also regionally important in the South West for a number of other rare or declining bee and butterfly species (but not IIA qualifying species) including Perkin's Mining bee (*Andrena rosae*), Large Scabious Bee (*Andrena hattorfiana*) and Long-horned Bee (*Eucera longicornis*), and Grayling (*Hipparchia semele*), Small Pearl-bordered Fritillary (*Boloria selene*) and Silver-studded Blue butterflies (*Plebejus argus*).

These important invertebrate populations rely on the West Cornwall and the Lizard IIA's unique range of habitats from heathland, clifftop grassland, coastal slopes and cliffs, to woodland and saltmarsh. Whilst parts of the IIA are under some form of legal protection (e.g. SSSI, SAC), there are considerable portions that are outside of any designated areas.

Key habitats for rare invertebrates in the 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; litter & ground layer; dung & carrion; and stones, boulders, shingle & scree) e.g. Tormentil Nomad Bee, Buff-banded Mining Bee, Golden Lantern Spider, Southern Mesh-weaver, Nose Gallows-spider, Western Groundling, Cliff Case-bearer, Cornish

Detritus Moth, the weevils *Protapion laevicolle* and *C. parvulus*, and the ground beetle *P. vectensis.*

- **Tall sward and scrub** (sward/field layer; litter & ground layer; nests; and) e.g. Cornish Groundling (*Nothris congressariella*), Wood Grass-veneer (*Crambus silvella*), Buff Groundling, Cornish Midget, the flea beetle *Ochrosis ventralis*, Marsh Fritillary, Limestone Ant Fly, Moss Carder Bee, Grass Money Spider, Blackwall's Crablet, and Limestone Ant Fly.
- **Acid and sedge peats** (including shallow freshwater pond; wetland vegetation; deep litter; sphagnum/ moss lawn; and wet/damp peat) e.g. the long-toed water beetle *Dryops auriculatus*, the weevil *Bagous collignensis*, the jumping ground bug *P. waltli*, Cigarillo Gall-fly, and the long-legged fly *S. mikii*.
- **Shaded woodland floor** (including woodland litter) e.g. the sausage millipede *C. sylvestre*, Great Long-tailed Winter Gnat, and the centipede *S. souletinus*.
- **Sea cliff** e.g. the leaf beetle *Longitarsus obliteratoides*, Sheep's-bit Weevil, Western Ground Spider, and Cliff Tube-weaver (*Segestria bavarica*).
- **Rocky shore** e.g. the centipedes *A. peregrinus* and *H. submarina*, and Shore Crevice Bug.
- **Running water** (including exposed riverine sediments; seepages; and unmodified fast flowing streams) e.g. Brown Diving Beetle, Rockface Beetle, and British Cave Shrimp.
- **Saltmarsh** (including saline silt; and saltmarsh vegetation) e.g. Grey Blite Case-bearer.
- **Sandy beach** (including saline silt; and tidal litter) e.g. the ground beetle *Bembidion nigropiceum*.
- **Saline lagoon** and **Brackish pool & ditches** (including pond/seepage edge) e.g. Looping Snail (*Truncatella subcylindrica*).

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

- **Arboreal**
- **Marshland**
- **Lake**
- **Wet woodland**

Habitat Threats and Opportunities

Heathland

Threats

- 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 undergrazing 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, bog and heathland carr due to drainage or otherwise changing hydrology can significantly reduce their value for invertebrates.
- Habitat fragmentation due to development pressure or agricultural improvement can create isolated patches of habitat, making dispersal 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.

Left to right: Provisionally Endangered Cigarillo Gall-fly (*Lipara similis*) © Marie Lou Legrand (CC BY-NC); Sheep's-bit Weevil (*Cleopomiarus micros*) © AWI i Pr. (CC-BY-NC); Buff Groundling (*Prolita solutella*) © cossus (CC BY NC)



- Footpaths receiving moderate use can be of very high value to invertebrates (e.g. by maintaining open bare ground). But excessive recreational pressure such as motorcycle activity or horse riding can alter vegetation communities through trampling, soil compaction and erosion, damaging habitat and affecting continuity.

Opportunities

- 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 and scattered trees.
- Aim to establish grazing of appropriate stocking levels, avoiding under or overgrazing, 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 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.
- Aim to establish a diversity of plant species to encourage a wide diversity of invertebrates as well as foodplant-specific species in this area such as Marsh Fritillary (on scabiouses), Meadow-sweet Pigmy (on Dropwort) or Buff Groundling, Cornish White-barred and Cornish Midget (on brooms).
- 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 can be a problem, it does support rare sawflies and flies, so areas of Bracken, both shaded and in the open, should be retained.
- Restore degraded or damaged heathland sites, including the removal of trees from plantation sites and restore open heathland habitat mosaics across the landscape to improve connectivity and to provide opportunities for invertebrates to develop resilient populations.
- Protect existing valley mires, wet heath, streams and ponds.
- Retain dead and decaying wood.

Cliff top grassland-scrub mosaic

Threats

- 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.
- 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

Left: White-moustached Jumping Spider (*Euophrys herbigrada*) © Tylan Berry. Right: The crawling water beetle *Haliplus variegatus* © Udo Schmidt (CC BY-SA 2.0)


Left: Tormentil Nomad Bee (*Nomada robertjeotiana*) © Steven Falk. Right: The centipede *Hydroschendyla submarina* © Tony Barber

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.

- 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.
- Invasive non-native plant species (e.g. Cotoneaster) can negatively affect the vegetation and structural composition of cliff top grasslands.

Opportunities

- 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.
- Aim to establish a diversity of plant species to encourage a wide diversity of invertebrates as well as foodplant-specific species in this area such as Western Thyme Plume and Western Groundling (on Thyme), and the weevil *C. parvulus* (on Smith's Cress).
- Try for 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 and creating germination opportunities.
- On agricultural land, create buffers (by planting wildflower strips of 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 plant species.

Coastal cliffs and slopes

Threats

- Cliff stabilisation measures can disrupt the dynamic natural processes of erosion and slippage that shape cliffs with soft geology, leading to stabilisation and the loss of habitats such as 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.
- The use of fertilisers and pesticides and loss of low intensity grazing on adjacent land can negatively impact on soil-dwelling invertebrates reliant on high quality cliff top habitats for foraging or for dispersal.
- The loss of natural processes such as slumping and slippage impedes the creation of new nesting habitat and the introduction of wildflower seeds to cliff faces from cliff top grasslands.
- Non-native species such as Sea Buckthorn and Sour Fig outcompete and shade out native species and adversely transform natural vegetation communities on cliff tops and slopes, tending to smother the bare ground required by many specialist invertebrates.
- Climate change increases the frequency of extreme storm surge events causing coastal slopes and cliffs to retreat faster than they would normally.

Opportunities

- Ensure Shoreline Management Plans recognise the importance of cliffs and slopes for biodiversity and avoid damaging management. Any activity that changes the natural rate of cliff or slope erosion, 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.
- Restore species-rich cliff top grassland habitat mosaics to provide forage for cliff-dwelling species and to improve habitat connectivity along the coast. Ideally, management should aim to create a mosaic of short and longer vegetation mixed with bare and stony areas and patches of scrub, which can be achieved by grazing or cutting.
- Drainage of cliffs by surface or sub-surface measures or by inland abstraction has a direct impact on the geomorphological functioning of sites and should be prevented.
- Scrub encroachment and the extent of invasive plant should be monitored and managed.

Wetlands

Threats

- Water pollution from agriculture (e.g. artificial or natural fertilisers, worm treatments, herbicides and pesticides including neonicotinoids), 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 bodies, 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

Left: Swiss Sac-spider (*Porrhoclubiona genevensis*) © Tylan Berry. Right: Great Long-tailed Winter Gnat (*Trichocera major*) © Иван Матершев (CC-BY-NC)

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.
- 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.
- Solar panels adjacent to wetland features can attract aquatic invertebrates with reflected polarised light appearing as suitable egg laying sites.

Opportunities

- 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.
- Aim for structural diversity in and around water bodies, including large beds of submerged vegetation and 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 places for invertebrates to shelter, feed and breed in.
- 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 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 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 able to colonise new sites.
- Patterned, roughened or painted glass, or a horizontal light-blocking grid can be used on solar panels to reduce their attraction to aquatic invertebrates.
- Cleaning and disinfecting 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.

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.
- Loss of woodland grazing or management such as maintenance of rides or coppicing, can lead to woodlands becoming shaded and the development of Ivy, Holly or bramble thickets, significantly impacting ground flora vegetation that provides nectar and pollen sources for invertebrates.
- Overgrazing and disturbance by deer, squirrel or rabbit populations 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 of associated specialist species and lead to the loss of populations.
- Fragmentation of woodlands can lead to inability of invertebrates to move between blocks of habitat.
- Invasive non-native species (e.g. Rhododendron,


Left: Limestone Ant Fly © Francis Birlenbach (CC BY NC). Right: Hairy-saddled Colletes (*Colletes fodiens*) © Nick Owens

Sycamore) can negatively affect the vegetation and structural composition of woodlands.
- Ash Die-back and other tree diseases and pests, which are exacerbated by the climate change, can result in changes in tree species and age composition.
- Pheasants and other non-native birds can impact invertebrate populations in woodlands by excessive predation.

Opportunities

- Overall, aim for a mix of deadwood, 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.
- Maintain/re-establish light grazing regimes in ancient woodlands to manage understorey vegetation.
- Retain all deadwood, both standing and fallen, in situ and discourage the collection of firewood. Additionally, retain trees showing decay features and do nothing to damage those features.
- Promote tree growth of suitable tree species 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, Sycamore and bramble.

Running water

Threats

- Water pollution and nutrient enrichment from agricultural run-off (e.g. artificial or natural fertilisers, worm treatments, herbicides and pesticides including neonicotinoids), 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 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

The dung beetle *Onthophagus nuchicornis* © Chloe and Trevor Van Loon (CC BY NC)

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.
- Residues of toxic chemicals from flea treatments can occur in freshwater due to sewer network discharges and dogs entering the water. These chemicals have the potential to affect the reproduction and growth of aquatic invertebrates.
- Light pollution disrupts the lives of nocturnal aquatic 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 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.
- To minimise the environmental impact of flea treatments, dog owners should only treat when necessary and choose products carefully considering their environmental impact and mode of application.
- Patterned, roughened or painted glass, or a horizontal light-blocking grid can be used on solar panels to reduce their attraction to aquatic invertebrates.
- Cleaning and disinfecting 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.

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