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Managing brownfields for flies

There are over 7,000 fly species in the UK, and the best brownfields can support at least one thousand of these, including an exceptional number of scarce species. Flies are an extremely diverse group with varied life cycles and can use many of the features within a brownfield habitat mosaic. However, flies are often overlooked and understudied, meaning the value of brownfields for flies, and their conservation needs, are often underestimated.

The importance of brownfields for flies

Fly assemblages can develop quickly on re-vegetating brownfield land and can include an exceptional number of scarce species. Surveys of the better sites suggest they are only rivalled by the best ancient woodlands or wetlands (Falk 2010). This is related to the variety of both wet and dry, open and shady conditions that can be present, varied soil chemistry and the unusually large flora that can be associated with brownfields. Many plants on brownfields grow in higher densities than in natural habitats, while bare ground on brownfields heats up more quickly, helping to support unusual thermophilic flies that struggle to colonise cooler sites.

Phytophagous flies (those that develop in leaves, stems, fruit or flowerheads) are very influenced by the flora. Picture-winged flies (Tephritidae) are one of the key families with numerous species able to exploit thistles (*Cirsium*, *Carduus*

spp.), ragworts (*Senecio* spp.), knapweeds (*Centaurea* spp.) and wormwoods (*Artemisia* spp.). Some picture-winged flies can attain unprecedented population levels on brownfields, and including several species that were largely coastal a century ago. Other key phytophagous fly groups include *Cheilosia* hoverflies which use thistles, ragworts, hawkweeds

Key groups of fly on brownfields

Picture-winged flies (Tephritidae, Ulidiidae), Hoverflies (Syrphidae), Snail-killing flies (Sciomyzidae), Flesh flies (Sarcophagidae), Bee flies (Bombyliidae), Soldierflies (Stratiomyidae), Robberflies (Asilidae), Long-legged flies (Dolichopodidae), Big-headed flies (Pipunculidae), Thick-headed flies (Conopidae), Leaf-miner flies (Agromyzidae) Dance flies (Empididae).



Phoenix fly (*Dorycera graminum*) © António Gonçalves



Dark-edged bee fly (*Bombylius major*) © Steven Falk

and umbellifers, and leaf-mining and gall-forming anthomyiid and agromyzid flies.

Flies can require very different habitats as larvae and adults. For example, *Stratiomys* soldierflies and hoverflies of genera like *Anasimyia* and *Helophilus* have aquatic larvae, but adults need flowers and warmth. For flies associated with ground-nesting bees and wasps, such as the Dark-edged bee fly (*Bombylius major*) or *Myopa* thick-headed flies, there is an indirect need for the sparsely vegetated nesting habitat and spring blossoming shrubs required by their host species. Other habitat features that can be involved include wet mud, decaying vegetation, carrion, mammal burrows, bird nests, fungi, dead wood, dung, specific plant species and topography such as sunny slopes or earth faces. As a result of these specific needs, large brownfield fly assemblages use a huge number of habitat combinations.

Lack of formal management and informal disturbance afford a unique character to brownfield land that can last for several decades until scrub and woodland begin to dominate. The best fly assemblages occur where there is a successional mosaic including young woodland, scattered scrub and bramble alongside diverse early successional habitats, grassland, tall herb and wetlands. Woodland, scrub and carr are extremely valuable when limited in extent, providing shelter, shade and spring blossom. The leaves of many scrub species are important for phytophagous flies, or parasitic and predatory flies (e.g. tachinids, big-headed flies, dance flies and certain hoverflies) that need caterpillars, aphids, leafhoppers, leaf beetles or shield bugs that eat shrub foliage. Key scrub species are willows (*Salix* spp.), Hawthorn (*Crataegus monogyna*), birches (*Betula* spp.), Gorse (*Ulex europaea*), Broom (*Cytisus scoparius*) and roses (*Rosa* spp.).

The disturbed nature of brownfields and the proximity to urban areas often allows sites to support a large number of exotic plants that have escaped from gardens, alongside native wildflowers. Some of these such as Canadian goldenrod (*Solidago canadensis*) and Michaelmas daisies (*Aster* spp.) can provide valuable nectar sources in autumn when there can be

Key brownfield habitat features for flies

- Ruderal early successional habitats.
- Varied topography and aspect.
- Permanent and temporary pools, damp hollows.
- Wetland features such as reedbeds, swamp and carr.
- Unmanaged grasslands with a varied structure.
- Scrub and carr for shade, shelter and spring blossoms.

a paucity of forage. However, despite their flowers attracting flies, some non-natives such as Buddleia (*Buddleia davidii*) can quickly dominate sites, displacing low-growing plants and reducing the quality of sites for flies.

Soil conditions on brownfields can mimic more natural habitats and have a major influence on fly assemblages. Calcareous brownfield sites can support many of the species associated with chalk and limestone grassland and scrub, but often in greater abundance. Examples include the picture-winged fly *Urophora solstitialis* on Musk thistle (*Carduus nutans*) and the various flesh flies and snail-killing flies that are predators of terrestrial snails. Sandy brownfield sites are often acidic and develop acid grassland or heathland. Some of the most interesting brownfield sites have a mix of calcareous and acid soils conditions, resulting in much richer floras, diverse soil conditions and diverse fly assemblages.

Very fine wetlands can develop on brownfields, with habitats dominated variously by Common Reed (*Phragmites australis*), bulrushes (*Typha* spp.), sedges (*Carex* spp.), rushes (*Juncus* spp.) and wetlands grasses such as Reed sweet-grass (*Glyceria maxima*). Key fly groups here include hoverflies, long-legged flies, soldierflies, and snail-killing flies. There can be more species of fly in brownfield wetlands than any other group of invertebrate. Wetlands do not need to hold permanent water as many flies are associated with seasonally wet pools or wet mud, or the plants that need those conditions.



The aphid-feeding Mugwort hoverfly (*Triglyphus primus*) © Steven Falk



Structurally diverse vegetation suitable for many flies © Clare Dinham

Brownfields have a major influence on the distribution of flies, allowing species that were once almost entirely coastal, such as the picture-winged fly *Campiglossa absinthii* and soldierfly *Stratiomys singularior* to occur far inland. The warm conditions associated with brownfields also allow various southern-biased species to occur further north than would be possible in other habitats e.g. the Dotted bee fly (*Bombylius discolor*). Brownfields therefore act as important stepping stones for many fly species and significantly increase the capacity of a landscape to support diverse fly assemblages. Old meadows, woods, wetlands, coastal grazing marsh and arable margins will all support more flies if there is brownfield habitat nearby and vice versa. Brownfields also allow flies to adapt their distributions in response to climate change and in future may play an important role in preventing the national extinction of some rare species.

Creating & managing habitat for flies

Promoting diversity is the key to encouraging a rich and interesting fly assemblage. Brownfield management should always be rotational, with only parts of a site managed in a single year to maintain a mosaic, avoiding using a single technique site-wide in a single year. This is essential to retain a habitat mosaic and prevent homogenisation of a site.

- Topographical variation can create a range of microclimates, differing soil conditions, wet and dry areas and diverse vegetation communities which can support more fly species. Machinery such as an excavator can be used to create hollows and the removed material used to create adjacent banks, hillocks and south-facing vertical faces. Hollows may develop the damp conditions favoured by some flies, whilst slopes may provide sparsely vegetated habitat for a range of species. Topography can be managed in a piecemeal manner by creating new humps and hollows on a cycle of 10-20



Mixed swamp supporting rich snail-killing fly assemblage © Steven Falk



Banded general soldierfly (*Stratiomys potamida*) © Steven Falk

years. This can be linked to the maintenance of early successional stages and stripping of any over-fertile soils.

- Creating areas of early successional habitat using varied cycles of disturbance and different types of disturbance activity will increase the range of conditions for flies. Disturbance in low nutrient areas will produce a better response than in higher nutrient soils. Disturbance regimes should operate rotationally to ensure a steady supply of newly disturbed areas for early successional habitats to develop. Over time this will ensure a mosaic of successional stages develop, providing diverse vegetation types and structures. Heavy machinery and work parties are useful, but rabbit activity and informal recreational activity such as trampling or cycling can both create localised disturbance and help maintain early successional stages.
- Grassland management should aim to retain a varied grassland and tall herb stands with plentiful umbellifers and thistles. If cutting is required for site management, long rotational cutting of grasslands should ensure that longer grassland, including tussocks with accumulated leaf litter,



Early successional mosaic with bird's-foot trefoils (*Lotus* spp.) © Steven Falk

are retained to provide structural diversity and overwintering sites. Any cutting should be undertaken in autumn after flowering plants have set seed, with arisings removed to lower site nutrients. These arisings can be piled up in specific areas and will help create additional habitat, both in terms of decaying organic matter, plus nutrient-hungry plants like Common Nettle (*Urtica dioica*), Hemlock (*Conium maculatum*) or Hogweed, that support various insects. Livestock grazing on brownfield sites should be a last resort, or done in a controlled way for specific purposes, as it can damage the disturbed and varied character of brownfield land.

- Clearing encroaching scrub, carr and trees will help maintain open habitat, but some areas should be retained as they are valuable habitats in their own right. Scrub and carr should be cleared in a rotational manner and the stumps treated to prevent regrowth. Leaf litter should then be scraped off to create bare ground for ruderal plants to colonise. Secondary woodland on brownfields can also be coppiced to diversify conditions. Arising can be piled up in a specific part of the site in log or brash piles as an additional habitat feature which provides shelter, overwintering areas and developmental sites for saproxylic (dead wood feeding) species. Flies need the shade and humidity of woodland, scrub and carr together with a lush herb layer of plants such as Common nettle and shade-loving sedges and grasses.
- Where a brownfield shows a natural tendency to become waterlogged, large scrapes and hollows can be created to encourage ephemeral or permanent pools to develop. Shallow-profiled pool margins and summer

draw-down will offer a range of depths for vegetation to develop and encourage the wet mud that the larvae of many flies require. Wetland features should ideally be managed in a piecemeal manner to ensure a diversity of types and degree of vegetation cover. Be careful not to eradicate all of one particular condition such as patches of reeds, bulrushes or Greater pond sedge (*Carex riparia*) in one go, but try to avoid any one of the conditions swamping out others. Willow encroachment can be persistent on brownfields, and is best controlled on a 5-10 years cycle to diversify carr conditions whilst maintaining some open wetland.

- Many brownfield sites can be enhanced by bringing in new substrates from external locations. This could be spoil or aggregates from local quarries, sandpits and gravel workings. These can help diversify ground conditions as different substrates may develop distinct vegetation, soil and drainage characteristics. Introducing calcareous aggregates can diversify the flora for picture-winged flies, and encourage the flies associated with snails. Introducing sand can encourage the flies associated with ground-nesting bees and wasps.

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Seasonally wet grasslands diversify site features © Jamie Robins



Striped slender robberfly (*Leptogaster cylindrica*) © Steven Falk

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