Green corridors in Farnham

1. What is a green corridor?

A green corridor is any feature or series of features in the landscape (or townscape) that can be used by wildlife (both animals and plants) for their migrations and/or dispersal. Ideally a corridor should be a continuous linear feature, but pragmatically the links will need to be discontinuous chains of habitat. It is being increasingly recognised that conserving biodiversity is basic to the maintaining the health and habitability of our cities, towns and countryside and the many ecological services on which we rely. This is one reason why we afford protection to our green spaces. Including our national, regional and local parks and reserves. However, as the human population grows pressures to expand the built infrastructure and hard structures these 'green centres' are becoming progressively more isolated and fragmented. Consequently, they are becoming increasingly vulnerable to both predictable (e.g. climate change) and unpredictable events (e.g. pollutant spills and fly-tipping, fires, floods etc). Unless positive action is taken to ensure connectivity is maintained across all habitats especially in urban areas losses in biodiversity will continue to accelerate and the environments in our towns and countryside will deteriorate for both wildlife and humans. Maintaining and creating connectivity between habitats either by continuous linkages of habitats or discontinuous chains of 'stepping-stones' across otherwise inimical habitats has not been included as an essential element in planning regulations. Human structures and activities not only cause degradation and fragmentation of the local environment and reduces inter-connectiveness between habitats, but also promote damaging events like wildfires and long-term environmental changes such as flodding and climate change

. Such reductions in connectivity have direct impacts on the local ecology increasing the vulnerability of local biodiversity hotspots to local extinctions cause by destructive events such as fires, pollution events or flooding. Without a green corridor enabling re-colonisation a species's range whether it is locally rare or common, will be eroded. Ecological interactions may well result in the localised loss of a species rippling across the ecosystems and having unexpected consequences. For example, reductions in the abundances of pollinators and/or animal seed dispersers can reduce the connectivity between plant communities, which can have a negative feedback on the abundance and diversity of animals. The loss of a keystone predatory species may result in unwelcome populations growth of pest species, which encourages the use of chemical pesticides. Conserving and improving the connectivity has the potential to reverse these trends.

2. The importance of green corridors?

Green corridors form links between habitats and reducing their isolation and hence their vulnerability. They are essential components providing connectivity across the network of otherwise fragmented habitats helping to conserving the biodiversity of each site. In urban areas there are mosaics of semi-natural habitat subdivided by many features that are inimical to wildlife (e.g. buildings, roads and pavements), in which any inhabitants other than humans and their domestic pets are generally considered to be undesirable. Within the urban landscape are habitat pockets that are oases for wildlife and provide stepping-stones facilitating the dispersion of species thus with potentially linking the wildlife populations. These stepping-stones include our urban parks, cemeteries, allotments, the few contaminated sites, and most importantly domestic gardens (constituting around 25% of the area of urban Farnham), recreational areas, localised patches of dereliction, roof gardens and even small features such as window boxes and the ornamental planters placed around the town for Farnham-in-Bloom. While the species composition found in these pockets is dependent on the dispersive capabilities of the individual species, the connectivity between similar habitats and the human management of the pockets, their effectiveness as stepping-stones is strongly influenced by the plants used. In the wider countryside the localised hotspots of biodiversity can be subjected to unpredictable events that have severe impact on species survival (e.g. the fires on Frensham Common, the 2016 winter floods in the Wey valley and the severe droughts of 2022). Within these hotspots, the possibility and rates of species recovery is dependent on the ability of the individual species to disperse, the distance between the stepping-stones and the degree to which their dispersion is hampered by barriers. Within an urban area like Farnham the presence of wildlife is limited by our environmental management protocols. Some of these protocols are determined by legislation determined by considerations of public needs for health and safety, flood control, and more and more by the financial costs of management, and environmental maintenance but others are for aesthetic reasons, the pursuit of tidiness and communal activity like Farnham-in-Bloom, and whims of public perception – many based in misconceptions

3. Dispersal

Dispersive mechanisms of animals and plants are very different but play a key role in the effectiveness of a corridor.

Plant dispersal: There are a range of mechanisms used by plants to disperse many but not all are relevant to the effectiveness of corridors.

1. Gravity: Many plants rely on gravity for disperse – especially trees. For example acorns and beech mast are dropped to the ground from high branches so will undergo very slow dispersal along a corridor by this mechanism. However, The fruits like acorns are rich in stored resources and so are feed upon and collected for winter storage by mammals and birds, which will move along green corridors.
2. Wind: very many species have winged seeds which are dispersed by wind - trees like willows and sycamore – herbaceous weeds plants like dandelion and groundsel. Their dispersal will not be enhanced very much by corridors, except when winds are funnelled along paths. One classic example is oxford ragwort, which after it was introduced into Britain, was dispersed. along railway lines. (The microscopic spores of mosses, lichens and ferns are wind dispersed and can be sampled in the Stratosphere; hence they are the initial colonisers of volcanic larva flows and islands).
3. Animals: Many plants have hooked seed which entangle with fur or clothing, and these are gong to be spread along paths and animal tracks.
   Many plants with edible fruits have seeds which can not only survive being passed through the guts of herbivores but also will not successfully germinate unless they have done so. Their dispersal will be dependent on the dispersal of their consumers.
4. Ballistics: There are a number of plants whose primary dispersal mechanism is by explosive seed pods e.g. broom and Himalayan balsam, but their dispersal is further enhanced by being carried in mud on the feet of animals (including humans)
5. Water: Many riverine plants have buoyant seeds that are dispersed by running water. Dispersal by water is most frequent but by no means restricted to aquatic plants.

Not all plant dispersal is by seed. The Invasive alien species Japanese knotweed is a dioecious (i.e. has separate male and female plants) species and curiously only male plants are found in Britain. However, it can regenerate from small fragments of rhizome (roots) and so has spread widely throughout Britain becoming a major pest species by being carried down waterways in flood waters or from spread in contaminated soils used in building projects.

Dispersal mechanisms that are independent of corridors include the aerial dispersal of the spores of cryptophyes - mosses and liverworts. For example, studies of the species that first colonise volcanic lava flows have shown that many are global in their distributions, because their spores get spread by the high-level winds, so these specialised species are exceptional in having global distributions.

Animal dispersal: As with plants animal dispersal can by several mechanisms-

1. Aerially by flying e.g. bats, birds and many insects. Some green corridors can enhance dispersion by acting as flyways.

2. Aerially: Wind-assisted 'paragliding' is seen in spiderlings using gossamer threads for airbourn dispersion. (Note the effectiveness of this method of dispersion is shown by spiders being the first animal species to colonise new formed volcanic islands, and spiderlings have been collected at considerable altitudes from aircraft). Clearly animal species that use this method are not dependent on corridors for their dispersion.
3. By locomotion: Most terrestrial species disperse either along the ground or through vegetation, but their dispersals maybe limited by various types of barriers.
4. Anthropogenic dispersal: Human movement and transportation can be responsible for the dispersal of species. Classic examples include Oxford ragwort, Himalayan balsam and Japanese knotweed.

Oxford ragwort (*Senecio squalidus*) Native to Mount Etna. Introduced to Oxford Botanical Garden in 1794. Spread along railway lines, by train movements and use of ballast.

Himalayan balsam (*Impatiens glandulifera*) Native to Himalayas. Introduced as a greenhouse plant in 1839. Spreads by having ballistic seed pods and disperse water and in mud on footware.

Japanese knotweed (*Reynoutria japonica* syn. *Fallopia japonica*). Native to volcanic spoils in Japan. Reproduction in UK is all asexual only by root fragments carried by water or in transported soils or ballast.

Species that are tolerant of a wide range of habitat conditions and have good dispersive capability are often considered to be 'weed species' (e,g, goundsel *Senecio vulgaris*) and are amongst the first species to re-colonise sites that have been heavily disturbed. Those with limited dispersal capability and limited habitat tolerance tend to be those that are of highest conservation concern and are least resilient to environmental change. There are differences in the dispersive capabilities of plants and animals. There are marked differences in the life history stages at which dispersal can occur. Natural plant dispersal is predominantly by seeds, but there is now extensive anthropogenic dispersal of plant species for agricultural and horticultural purposes, which can inadvertently lead to the dispersal of associated diseases and animal species (e.g. the introduction of the Boxworm moth Cydalima perspectalis) and the introduction of invasive alien species into Britain (e.g. Rhododendron ponticum).
The dispersal potential of animal species varies considerably during life and annual cycles.
These can be summarised under different headings:-

a. Daily ambit.

Each species daily covers a spatial range that may vary from virtually nothing (e.g. aphids on a bean shoot) to many kilometres (e.g. red kites).

b. Annual ambit.

The ranges of individuals of a species can be highly restricted limited to a few metres (e.g. woodlice in the garden), to several tens of metres (e.g. snails roaming a garden), to hundreds of metres (e.g. amphibians migrating from breeding ponds to summer feeding sites and hibernacula), to many kilometres (e.g. birds moving internationally from breeding grounds to overwintering sites). These long-distance migrations (are best documented for birds such as swifts, but now identified in some insects species such as the silver y (Autographa gamma) that migrates from Southern Europe to Britain in early summer produces a generation that then returns south again in early autumn where it breeds again, but some are still not fully understood such as the migrations of the 1-cm long diamond-backed moth *Plutella xylostella*.

c. Dispersal movements

Many species have a dispersal phase in their lifecycle. For example adult foxes force away their maturing cubs in early autumn. The nuptial swarming flights of ants and bees ensure the spread of the species to all suitable habitat with range.

d. Enforced/Enabled migration

Habitat destruction (by fire and flood) and changes in land use will result in immobile species dying out and force mobile species to seek new sites. One effect of climate change is to either enforce or enable species to extend their ranges – thus the wasp *spider Argiope bruennichi* in the years after WWII was predominantly a coastal species but has spread northwards and occurs regularly in some habitats around Farnham. Now climate change is enforcing species to move latitude or altitude to find tolerable climatic conditions, which may result in population declines if for example another species on which they depend is absent from their new location (e.g. insects which depend on specific food plants).

e. Assisted migration.

Species with restricted mobility which have arrived locally as a result of being accidentally introduced by movement of agricultural or horticultural plants or foodstuffs. There is an increasing inventory of such adventive species in and around Farnham for example the terrestrial amphipod *Arcitalitrus dorreini* found in woodland around Farnham in 2015 was first described from specimens found in the Scilly Isles but was subsequently found to be an Australian species possible introduced in the root balls of imported tree ferns. How they got to Farnham remains a mystery.

f. Species' ranges.

The geographical range across which a species occurs is determined basically by its ecological requirements and may be restricted to areas in which these requirement are met. However, a species will not necessarily occur wherever these requirements are met, because there are barriers which prevent their dispersion. These barriers may be natural (e.g. aquatic species cannot move across dry land except at times of flooding), or anthropogenic (e.g. roads, buildings, industrial artefacts, agricultural activities). Understanding barriers to dispersion is a fundamental requirement for the effective creation, protection, and management of green corridors. Current ranges often result from events in the past. Thus, distributions of species around Farnham have been influenced by events in the geological and historical past – e.g. the formation of the Weald in the geological past, the impacts of the Ice Age glaciations in determining the superficial geology and the river course of the River Wey, changes in agricultural practices, the establishments of the road and rail networks, landscape manipulations during the 20th century World Wars and so on.

4 . Types of green corridor

There are many features in urban landscapes which can act as green corridors.

a. Hedges

Hedges provide a diverse set of microhabitats that potentially can support large numbers of animal species. Ancient hedgerows (defined as having existed prior to the Exclosure acts (1720-1840) are considered to be identifiable by having 5 or more woody species per 30m stretch) Are particularly important and are protected under there by the **Hedgerow Regulations 1997**. However, this protection can be waived if the hedge compromises road safety- for example, the ancient hedgerow bordering the B3001 near Compton Copse is threatened with partial destruction in a recent housing development proposal. Hedgerows need to be managed and their effectiveness in boosting biodiversity is influenced by how they are managed.

The planting of new hedges can boost biodiversity, but the full benefit may not be fully realised for decades, even so it is preferrable over the erection of hard fencing. However, the effectiveness of a newly planted hedge is strongly influenced by the plant species chosen. Inevitably, developers favour the planting the cheapest and the quickest and most easily established species and this usually means laurel, because the plants are cheap and reliable and robust. Unfortunately Laurel hedges are not only wildlife unfriendly but also rapidly get out-of-control if not managed properly. Laurel spreads rapidly and in nearby woodland will supresses the ground flora and lowers local biodiversity. Despite the introduction of strict legislation regarding the removal of ancient hedgerows there are still planning proposals being submitted for developments which include the removal of sections of ancient hedgerow to enable road to be widened and to facilitate access to sites.

b. Roadside verges

Verges have considerable potential as green corridors and existing verges can be managed in win-win ways (by establishing a proper mowing regime and not using herbicides). These will not only increase biodiversity but also save money. Over-management of the UK's verges has resulted in an estimated 20% decrease in plant diversity since 1990. Plantlife has published guidelines for the management of verges, and these should be adopted along Farnham's Roads. The verges along the A31 by-pass offer considerable potential for increasing plant diversity and hence insect diversity. Note some verges (e.g. along A31 south of the town) now support salt tolerant species that are more usually associated with salt marshes, as a result of applications of salt during cold winters. Unfortunately the general public has a passion for tidiness – 'tidiness is next to Godliness' and there are many complaints made to the local authorities if verges are not kept smoothly trimmed.

c. Railway tracks and embankments

These are managed by Network Rail which has a biodiversity policy. The sides of the tracks and embankments provide an almost continuous line of habitat through the town, but the understandable limitations on public access means their role as corridors cannot be assessed. The classic example of railway embankments acting as corridors for dispersion is the country-wide spread of oxford ragwort along railway lines from the introduction centre in the Oxford Botanical Garden

d. Tunnels and underpasses

The A31 has the only underpass in the town. All roads are barriers to dispersal, not only because there are dangers of collisions with traffic, but there are increased risks of predation. We note there have been marked diminution in the last decade in the numbers of hedgehog road-kills in the Farnham area, which is almost certainly results more from the declines in hedgehog populations than to drivers being more careful or hedgehogs developing road sense. The numbers of badger and fox kills especially during late summer when the young are dispersing do not seem to have reduced recently and may only be reduced if more wildlife underpasses are constructed.

Recent studies in Hong Kong have demonstrated how busy roads can be barriers to the dispersal of flying insects, so that there are marked differences between the assemblage of insects between the two sides of a motorway. There has been almost no research into how roads prevent barriers to dispersion except for the harmful effects of street lighting on the wildlife inhabiting roadside verges (see Boyes et al. 2021 Science Advances, Vol 7, Issue 35 DOI: 10.1126/sciadv.abi8322.)

e. Avenues of trees.

Farnham has several tree-lined roads. Tree canopies provide important pathways for the dispersal of flying and arboreal wildlife, as well as providing many other environmental services (landscaping, shade, reduction of noise and air pollution). There are pressures to removed trees from roadsides to reduce leaf fall, avoid root damage and to reduce the danger of collisions. While some of these pressures are hard to resist, there should be a policy of replacing any tree removed.

f. Urban gardens and other open spaces

Private gardens occupy an estimated 25-30% of Farnham's built-up area and make significant contributions to enabling the movements of wildlife. Town centres are 1-2˚C higher than in the surrounding countryside and provide important resources and shelter for over-wintering species, especially where the home-owners keep bird-feeders stocked, have refuges such as bee hotels and have garden ponds and plant pollinator-friendly species. The sizes of gardens tend to be smaller towards the town centre, reflecting both the historical development of the Town and because the value of land is higher in the centre than around the town's periphery. Open spaces owned by public authorities are multifunctional but biodiversity is given relatively low priority, but for example the fringes of the car parks are surprisingly rich in insects and its cemeteries such as the

West St Cemetery support a varied array of insect species. Well managed gardens will be significant 'stepping stones' for the dispersion of insects across the built area of the town.

g. Ditches and minor water ways

These are linear features, which in the town centre tend to be canalised or buried. They provide a crucial service for flood control so their role in supporting biodiversity tends to get overlooked. Ditches tend to become overgrown rapidly if they are not constantly kept clear. There is also the temptation to discharge contaminated waters into them and discharges of raw sewage are permitted from treatment plants and pumping facilities during periods of heavy rainfall. These discharges will contaminate the River Wey in Farnham which is classified as a chalk stream. The management of the town's ponds and ditches needs to take account of their role in maintaining biodiversity especially with regard to their role as breeding sites for Amphibians

h. Field margins

The field margins in Farnham are predominantly, but not exclusively, in the north-west of the town. The majority of the fields are used for grazing horses (and to a lesser extent sheep, cattle and vicuna) as opposed to being used for arable land. Mostly the margins are managed by the private land-owners. They function partly to define the boundaries and partly to restrict movements of stock and the public in and out of the field.

i. Streams and rivers

The River Wey is probably the most important green corridor through the town. Its tributaries are also important corridors (i.e. The Nadder, the Bourne Stream, the Frensham Vale Stream, and the Coxbidge Stream).

5. Barriers to dispersal

When considering green corridors the barriers to dispersion also need to be considered. What constitutes a barrier varies according to what controls the 'mobility' of a species and the distances between suitable habitats.

Plant distributions are in part determined by the way seeds are dispersed, but once a seed is deposited other factors determine whether it successfully germinates and survives. There are some significant exceptions for example Japanese knotweed is dioecious and all the plants found in the UK are male, so they cannot reproduce by seed. Instead, the plants reproduce asexually being dispersed as root fragments either in soils that are transported between construction sites or eroded from the banks of water courses. For most plants seed dispersal is affected by a wide assortment of mechanisms - the dispersal mechanism utilised influencing the stricture o the seed:-

1. wind (e.g. seeds of willows than can resemble snow at times, dandelions with their round parachute-like wings, the winged seeds of birches and sycamores that can be blown across large distances),
2. by 'zoochory' the feeding of animals on fruits and seeds – for example as a result of the caching of nuts and acorns by small mammals and jays, and also the seeds contained in edible fruits surviving passage through animal guts (indeed there are seeds which will only germinate if they have passed through the guts of a herbivore.
3. by explosive seed discharge (as seen in Himalayan Balsam and some legumes like broom),
4. by exploiting animal movements (e.g the hooked seeds of cleavers). (Have you tried culturing the mud stuck on your boots after a muddy walk or working in the garden?)

The effectiveness of dispersal is then dependent on the seed being deposited in suitable habitat where germination can be successful. Some plants have very broad tolerance of environmental conditions (e.g. many of our garden and agricultural weeds), whereas others have very specific environmental requirements (for example there are species that will only grow on alkaline chalky soils and their calciphyllous distributions reflect the local soil chemistry).

Those species which are wind dispersed have few barriers to their distributions but are often limited by their environmental requirements. Plants with seeds that are disperse by water are confined to water courses, whereas those disperse by animals are constrained by the behavioural habits of their transporters.

Animal dispersal is likewise constrained by a variety of behavioural, physical and ecological factors. Clearly species that can become airborne are less constrained than those that are earthbound. However, the ability to be airborne is not totally confined to animals with the power of flight – for example some spiders disperse as spiderlings by using gossamer threads to take to the air, scavenging mites hitch rides on flying sexton beetles to move to new corpses, and the eggs of some otherwise terrestrial species can be blown as dust by winds. Flight may be limited to special phases of the life- history, for example the nuptial flights of queen ants. The range over which flying animals can disperse varies greatly between species. There is a tendency for larger species to have greater flying ranges than smaller ones, but this is by no means a hard and fast rule. Species of butterfly and moth can disperse over surprisingly long distances: the diamond-backed moth *Plutella xylostella* is about 1 cm long, yet every year it arrives *en masse* in all counties of the UK coming from the European mainland. Other species of butterfly and moth like some bird species undertake annual migrations to and from the Continent and even Africa. Clearly the dispersal of these species is constrained by barriers nor is it dependent on local corridors but is determined by local habitats once they have arrived.

Barriers to the dispersal of earthbound species are determined by a raft of physical and behavioural constraints. Thus a tarmacked may limit the dispersion of an adder not because of it being unable to move that far, but because behaviourally it will not move across open environments even at night. Conversely amphibian like frogs, toads and newts will migrate along roads to reach their breeding ponds, and it is the availability and suitability of the ponds which limit their distributions. Constraints on the distribution of bats are determined by the availability a suitable roosts and nursery sites but many species are deterred by artificial lighting. Other mammalian species are constrained by physical barriers to their ranges, so the widespread use of impenetrable fences around gardens in Farnham may be one of the critical factors limiting the distribution of hedgehogs in Farnham.