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Introduction

Over the past 20 years, 28% of the plants, 56% of the birds and 76% of the butterflies in Britain have declined in numbers.

Some of the threatened species are garden visitors, for example song thrushes, bullfinches, tree sparrows and some types of bumble bees and butterflies. (Science vol. 303. p1879)

Gardens and allotments, especially those in cities are important habitats for wildlife as they provide food, shelter and breeding sites. We do not really know the full consequences of the threatened extinction of so many species except that it is likely to diminish the quality of life for all of us. By gardening in harmony with nature, people benefit as much as the other species belonging to the planet.

Biodiversity is the variety of living things on earth, from the smallest insect to the largest mammal and tree. It encompasses the variation within a species and the complex ecosystems or habitats where they are found. It is not just restricted to rare species or threatened wildlife sites, but includes the whole of the natural world.(Glasgow City Biodiversity Action Plan).

This booklet brings together some of the best ideas of how biodiversity can be enriched in gardens and allotments. Many of these ideas are simple. They can be incorporated easily without changing the essential purpose of a garden as an area of land to be cultivated for the production of vegetables, fruit and flowers.



Gardens, Allotments and Biodiversity

As gardeners, we learn quickly that we are just one of many species in the natural world of a garden. This biodiverse habitat teeming with life throughout the seasons is a partnership from which we all benefit when we follow good gardening practices.

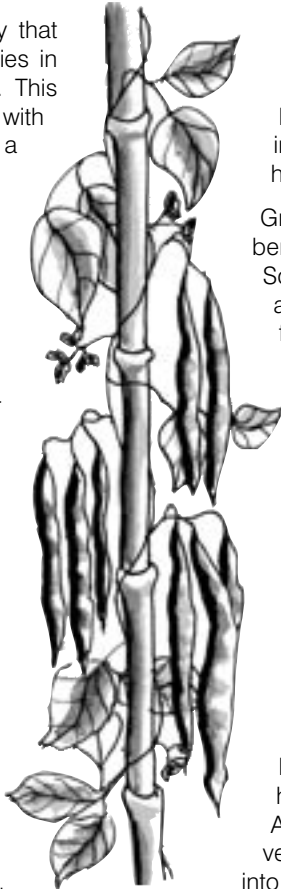
Many gardeners:

Add Compost: In spring, earthworm activity is increased when organic matter such as composted vegetation or farmyard manure is worked into the soil. This helps to keep it open and aerated and also retains moisture near to the roots of summer crops.

Rotate vegetable crops: This basic but essential practice helps not only to prevent the build-up of crop specific, soil based problems, but helps maintain the nutrient balance across the whole area of the garden.

Grow a range of fruit, vegetables and herbs: The early flowers of gooseberries and currants offer nectar to emerging bees and other insects. Later in the season the flowers of vegetables and herbs will provide that nectar. Different flowers attract different insects and pollination depends on their visits.

Companion plant: Certain plants grown together help to reduce attack by pests and disease. For example onions or leeks grown with carrots help to deter the



carrot fly. French marigolds grown with tomatoes make whitefly infestation less likely. Pollination can also be improved by planting flowering herbs among the vegetables.

Grow some native flowers and berry bushes: Plants native to Scotland flourish in our climate and soil conditions, producing flowers, berries and seeds. More than 70% of our birds depend on insects which in turn, depend on plants.

Provide water: A regular supply of water in a shallow dish which has a few pebbles at the bottom to give varied depths will attract a variety of creatures. Ponds are a feature in many gardens.

In the autumn provide food and shelter for wildlife: The seed heads and foliage are left on herbaceous perennial plants. A pile of fallen leaves and other vegetation, or leaves raked up into a netted container with access spaces give shelter to frogs, toads, hedgehogs and field-mice.

Remember

No matter how you work your garden, it is a habitat for wildlife and you don't need to have a wilderness to attract it. You can make a real difference by observing what is around you and thinking about how your usual gardening activities might affect wildlife.

Common Areas and Biodiversity

Some of the richest wildlife areas in gardens and on allotments can be found around the boundaries. A few simple actions can increase biodiversity, improve security and enhance the view at the same time.

Fences can be used as frames for climbers such as russian vine, clematis, roses and honeysuckle. The addition of ivy with its thick, evergreen growth providing all year round shelter, ensures the transformation of an uninteresting structure into a wildlife haven.

Fences can be concealed within a mixed hedge of hawthorn, blackthorn, holly, pyracantha, bramble and roses. Over several seasons, the mix provides a variety of attractive, nectar producing flowers. The berries provide food while the bushes themselves give shelter for resting and nesting. The thorns are an effective deterrent to intruders.

The ground underneath the hedge offers food and shelter amongst leaf mould and twigs for a multitude of insects that, in turn, become a food source for birds, small mammals and amphibians. In winter, a robin will often do bed and breakfast amongst the tufts at the base of a hedge.

Wild area. On most gardens there is a small piece of ground somewhere, which for some reason cannot be part of a plot. It may be under trees or too wet or too stony to cultivate. Left on its own, it becomes a tangle of grass, thistles, willow herb and nettles with a few brambles adding to the variety of growth. An awareness of the needs of wildlife reduces the temptation to tidy it up.

A log pile left to rot down gives a home to frogs, spiders, millipedes, centipedes, ground beetles and when well rotted will be inhabited by wood feeding creatures.



Caution

Nesting boxes. If these are used, great care must be taken to site them in a quiet spot, sheltered from extremes of weather and well away from hungry cats. The boxes should be accessible as they need to be cleaned out after the birds finish nesting.

Strimmers. Before starting to trim, always look through the undergrowth to check that there are no hedgehogs, toads or frogs which could be mutilated or killed.

Bonfires (if permitted). If the material has been piled up in the same place for any length of time, move it to a fresh site before setting it alight so that any sheltering creatures such as hedgehogs, frogs, or toads, can escape incineration.

Gardens, Allotments and Conservation

Peat

In the past peat was recommended for improving soils and for potting composts. However we are now aware that the extraction of peat threatens valuable wildlife habitats and gardeners are encouraged to use alternative products.

Timber

Extraction of timber also affects wildlife habitats. Ideally all wood used on sites should come from local and/or sustainably managed plantations. British grown hardwoods and spruce, pine and larch from other European countries are available in many stores.

Try to avoid using tropical hardwoods or any timber that may contribute to the loss of natural woodland anywhere in the world.

Fence posts, panels and other products sold for use in the garden are often treated with anti-rotting chemicals to increase their resistance to attack by bacteria and fungi. To avoid using these chemicals, ploholders could:

- Accept that untreated wood will not last so long.
- Reuse old wood wherever possible.
- Treat with one of the natural wood preservatives containing vegetable oils and tree resin.

Water

Water is a valuable resource that should not be wasted:

- Collect water into storage butts from the roof of huts or glass houses.
- Retain moisture in the soil by using organic compost and mulches.

- Use a watering can to direct water only to the roots of plants where it is needed, rather than wasting it on areas which do not require water.

Alternatives to pesticides

Instead of using pesticides you can:

- Help plants to withstand attack from pests and diseases by providing the conditions required for healthy growth.
- Create the conditions for natural predators to control pests.
- Learn about the life cycle of the pest or disease so that preventive action can be taken at the right time. For example, use a physical barrier to deter a pest, put out a slug trap, pick off the caterpillars by hand or prune diseased and damaged stems.

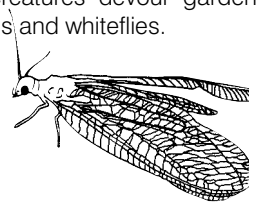


Beneficial Creatures



Gardens and allotments provide the perfect environment for many types of beneficial creatures which assist the plot-holder in a number of ways:

- Insects pollinate the flowers of fruit and vegetable plants in their search for nectar.
- Birds, insects and other creatures devour garden pests such as aphids, mealy bugs and whiteflies.
- Earthworms help maintain the soil's quality.



It is essential that we ensure these creatures are happy to continue visiting and living on our sites.



Some of the ways in which we can encourage them to stay:

- Avoid the use of chemicals. Although these products destroy pests, they also kill beneficial creatures.
- Provide shelter. Magpies and sparrow hawks are frequent visitors to gardens where they can make short work of sparrows and blue tits. Dense shrubs and hedges can hide small birds and fledglings. Dark, damp, undisturbed places provide concealment in the summer and shelter in the winter for insects.
- Provide food. Grow a range of plants which provide pollen and nectar for insects and berries for the birds.
- Provide water. Butterflies, birds, insects, amphibians and mammals all need access to water. Just a bowl containing pebbles, almost filled with water allows them to drink safely.



Table 1: Pollinators, predators and parasites

Insect pollinators		
Bumble Bees	Bumble bees are much better pollinators than honey bees. There are both long and short tongued species that pollinate different types of flowers.	Plant native wildflowers as well as cultivated varieties. Bumble bees breed and hibernate in rough, undisturbed areas.
Butterflies	Butterflies pollinate a wide variety of species of plants as they feed on the nectar of flowers.	Grow plants with purple, violet, orange or yellow flowers such as buddleia, hebe and most herbs. Nettles are the only plant the caterpillar of the small tortoiseshell butterfly will eat.



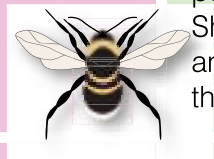


Insect predators		
Hoverflies	Larvae feed on aphids & mealy bugs. Adults are useful pollinators.	Grow plants such as yarrow, marguerite and french marigold; herbs such as lavender, thyme and rosemary.
Lacewings	Larvae devour aphids, mites, thrips and other small pests. Adults are useful pollinators.	Plant yarrow, goldenrod and asters.
Ladybirds	Adults and larvae consume large quantities of aphids, mealy bugs, whiteflies, mites and scale insects.	Grow yarrow, cosmos, and coreopsis.
Ground Beetles	Slugs, snails, cutworms, flat worms and root maggots are devoured by these busy creatures.	Provide them with shelter under a pile of logs or stones in a corner.

Other predators		
Birds	Birds keep pests at bay all year round in their search for food.	Plant hedging containing native species - hawthorn, bramble and dog rose, which provide both shelter and food.
Frogs and Toads	Frogs and toads eat almost any live prey they can find including insects, slugs and snails.	Provide a small pond somewhere on the site.
Hedgehogs	Slugs, snails, beetles as well as worms are food sources for these creatures.	Provide shelter such as piles of leaves or grass. Hedgerows are their preferred habitats.
Bats	Bats feed on craneflies, aphids, moths and midges throughout the spring, summer and autumn.	Bats feed at night so grow night scented flowers to attract insects that will provide food.

Insect parasites		
Wasps (parasitic)	They lay their eggs inside other creatures such as caterpillars which are then killed when the larvae develop.	There are many species of parasitic wasps in Britain. Some are very tiny. Most are attracted by fruit or flowers.

Table 2: Life cycles

Information on the life cycles of four familiar creatures. Each brings different benefits to gardens through

Beneficial Creatures	Spring		Summer
<p>Ladybirds</p> 	<p>The adult emerges from hibernation and lays her eggs in aphid colonies.</p> <p>The larvae of ladybirds feed on aphids.</p>		<p>Ladybirds and their larvae feed on aphids throughout the summer.</p>
<p>Bumble Bees</p> 	<p>The mated queen bee emerges from hibernation and feeds on nectar and pollen from spring flowers. She begins to lay her eggs and worker bees hatch three weeks later.</p>		<p>Eggs continue to hatch and bees feed on nectar and pollen throughout the summer.</p>
<p>Hedgehogs</p> 	<p>Hedgehogs emerge from hibernation and begin breeding.</p> <p>The young are born in a nest specially built by the female for this purpose.</p>		<p>Hedgehogs slugs and snails and feed after hibernation. Their diet of slugs, snails and other small insects. An adult male can travel up to 3 km in one night.</p>
<p>Blue Tits</p> 	<p>7 - 12 eggs are laid in late spring.</p> <p>On average a pair of adults rear two broods each year.</p>		<p>Fewer eggs are laid in the summer. Blue tits feed on insects throughout the year. Adults visit the nest to feed their young hatching several times in one day.</p>

ghout the year.



Autumn



Winter



their larvae
s throughout

They seek out places in which to hibernate for the winter.

Adults over-winter in bark litter or tree stumps.

to hatch
from nectar
rich flowers
summer.

The mated young queen bee searches out a place to hibernate for the winter e.g. a pile of leaves.

The old queens, worker bees and drones all die at the first frost.

Only the young queen survives to hibernate over the winter.

keep all day
dark on a
nails, beetles
all creatures.
e can travel
ght.

A nest is built, suitable for hibernation purposes. Piles of grass or leaves beneath a hedgerow are a favourite choice.

Hedgehogs hibernate all though winter and emerge as the days begin to warm up in the spring.

are laid in
e tits feed
and larvae
(caterpillars)
e summer.
nest to feed
hundreds of
y.

Additional food in the form of berries, fruit and seeds is eaten during this season.

Blue tits shelter in cavities of trees over the winter. They find grubs in the bark of trees and shrubs, as fat-rich food is needed. Berries and grass seeds are also essential for their survival.

Ponds

Making a pond is one of the easiest and most effective things that you can do to improve the biodiversity of a garden and the results can be seen in a very short time.

Water is essential for wildlife. Ponds not only provide breeding places for frogs, toads, dragonflies and newts, but also provide drinking places for a whole host of other creatures such as field-mice, squirrels and birds. Even a small pond will be appreciated and occupied by small creatures which will find it by themselves, especially if there is another pond nearby.

Caution - ponds should not be accessible to very small children.

Building a pond:

- Site it in a sunny, sheltered spot. It should be in the sun for most of the day, although if it is a very small pond have some border planting to give light shade over part of it for some of the day.
- Avoid over-hanging trees. Leaves rotting in the water will reduce the amount of oxygen in the pond and this may kill some of the inhabitants.
- One side of the pond should be fairly deep to allow aquatic creatures to hide and so survive very hot and very cold spells.
- The other side should slope up to ground level so that toads and frogs can get out of the pond. Instead of a slope, you can gently step the base to provide different depths for different plants.
- The shallowest step can be



separated from the main pond by a water permeable barrier, then filled with soil and planted as a bog garden.

Planting a pond:

- Around your pond plant enough vegetation to give cover for the amphibians and escape routes for dragon and damselflies. But make sure you leave enough open areas for timid birds to come down and drink.
- To help deter algae, add oxygenating plants, preferably native plants such as water buttercup or one of the pondweeds.
- Avoid rampant growers. Planting in pots controls the growth of plants in small ponds.
- Choose a selection of plants; different types will please different creatures.
- Remember to top up the water levels in dry weather. Rain collected in a water butt is ideal for this as it supports conservation.

Ornamental fish are not a good idea as they eat a lot of tadpoles and insect larvae. Fish may also make the water rather murky.

Clean your pond in the autumn to avoid disturbing hibernating creatures and when you remove any vegetation or silt, leave it at the side of the pond for at least a day to allow any trapped pond life to escape back into the water.

Avoid using fertilizers nearby as run-off could pollute the water.



Hedging

A thick hedge around a garden or allotment site is valuable as it can deter unwelcome intruders while providing food for insects, birds, mammals and humans. It is an effective windbreak, a shelter belt and a superb wildlife habitat. A hedge can also act as a green corridor which allows wildlife to move from place to place in relative safety.

A good hedge should be planted in a double row 15cms wide with 25cms between plants. Hawthorn is a valuable hedging plant as it is known to attract over 200 species of insect which in turn are important food sources for birds, bats and mammals. A mix of hawthorn and blackthorn as the main hedging plants is ideal and they can be interspersed with other species to give a variety of flowers and berries over an extended period of time.

It takes about four years for a hedge to grow to become an effective hedge and it should be pruned hard in the first two years to ensure that there is a good thick

growth at the base. After that if different parts of the hedge are trimmed every other year there will, each year, be flowers and berries. Faster growing plants like roses and brambles can be used to fill gaps. Small trees such as crab apple, rowan, bird cherry or hazel would increase the diversity of the plant species and provide additional food for the wildlife.



If a particularly strong barrier is required, the hedge can be layered - that is the branches are cut almost through and interwoven. Planting of the thornier species can help make an impenetrable hedge.



Table 3: Hedging plants

Hedging plants	Flowers and Fruit	Benefits
Blackthorn (sloe) Prunus spinosa	White flowers March to April. Sloes in autumn.	Thorny. Insects and humans. (jam and sloe gin)
Worcesterberry Ribes divaricatum	Flowers in March. Fruit July to August. Hybrid with gooseberry and blackcurrant parents.	Very thorny. Insects and humans. (jam and stewed fruit)
Holly Ilex aquifolium	Flowers April to May. Berries (poisonous) in autumn.	Prickly. Birds. (Christmas decorations)
Cotoneaster Rosaceae family (there are 200 species)	Flowers late spring with many berries in autumn.	Birds and insects especially wasps.
Hawthorn Crataegus monogyna	Flowers May to June and haws in autumn.	Thorny. Birds and insects.
Guelder Rose Viburnum opulus	Flowers June to July. Fronds of red berries in autumn.	Insects and birds.
Firethorn Pyracantha (many species)	Flowers early summer followed by berries in autumn.	Nectar for insects and berries for birds.
Sweet Briar Rosa rubiginosa	Flowers June to July. Rosehips in autumn.	Thorny. Birds and humans (rose hip syrup for Vitamin C)
Honeysuckle Lonicera periclymenum	Flowers June to September with berries in autumn.	Birds, moths and bees.
Bramble Rubus	Flowers July to September. Fruit August/September.	Very thorny. Insects and humans (pies and jam)
Buddleia Buddleia davidii	Flowers summer to autumn.	Butterflies.

The Living Soil



Soil life is the collective term for all the organisms living within the soil. Good healthy soil provides plants with the right amount of nutrients, water and air. Understanding the characteristics of soil will help you improve your soil's health and the overall health of your allotment or garden. A number of things are responsible for the formation of a stable, healthy soil. The presence of organic matter and soil life is vital to a soil's fertility and structure.

Organic matter

Soil organic matter is any part of the soil not derived from mineral origins. In nature it is deposited all the time from fallen leaves, dead and living plant material, remains of dead animals and animal waste. In cultivated situations we add farmyard manure and the content of compost heaps. This material is essential for improving the structure of the soil as it breaks up heavy clay and increases the moisture retentive properties of sandy soil.

Soil micro-organisms

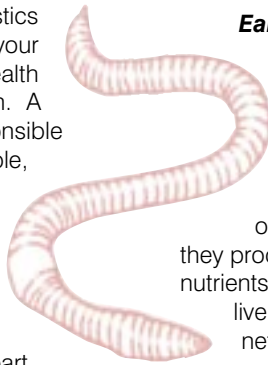
Within the ecosystem of the soil there are tiny fungi, bacteria, protozoa, very small insects, larvae and worms. These are all involved in the process of decomposition of organic matter. This is a complex process with many stages which, overall, is extremely beneficial to the soil.

Some of the benefits of this continual activity are:

- Helping the structure of the soil.
- Making nutrients available to plants.
- Enhancing drainage and aeration.
- Improving the soil's capacity to hold water.

Earthworm activity

Earthworms are one of the most important creatures living in the soil. They require food like all other living organisms. Besides the minerals in the soil they require organic matter in the form of decaying vegetation. The casts they produce breakdown further to provide nutrients for the roots of plants. Earthworms live underground, creating a vast network of tunnels that help air and water circulate throughout the soil, benefiting plant roots and other soil living organisms.



Other beneficial soil living organisms

Moles, insects, larvae, millipedes, centipedes, woodlice and ground beetles all improve the soil. Their burrowing, feeding activities and waste products aid the incorporation of organic matter, help soil drainage, aeration and prevent soil compaction.

Compost

Composting is part of the natural cycle of growth and decay. Essential in this process are numerous microscopic organisms of both vegetable and animal origin which break down the vegetable matter and in this way release nutrients into the soil in a form which plants can use. In turn, the plants provide food for the insects which then become food for the birds.

When we harvest plants for ourselves, we disturb this cycle by removing part of the natural ecosystem. Over a period of time, if we continued to remove and not replace plant material, the soil would become infertile and unproductive because it would be deficient in essential nutrients.

Of course, artificial fertilizers can be used to provide nutrients. However, they do not support the growth and the activity of the important and beneficial micro-life in the soil. Nor do they improve the structure of the soil. They do deplete the world's fossil resources. Organic fertilizers such as bone meal, blood and fish meal can be used, but many gardeners are reluctant to use these by-products of animals.

Farmyard manure is a good source of nitrogen, but garden compost, because of its more varied micro-organisms produces a wider variety of nutrients. By using compost and working in harmony with the land our plants benefit.

Micro-organisms break down the vegetable waste to form humus, a brown crumbly

substance with an earthy smell. The rate at which garden waste is converted to humus or good compost, depends upon a combination of adequate warmth, air access and moisture. Different combinations of these are used in making compost: anaerobic (cold and slow) aerobic (hot and fast) or worm composters (good for kitchen waste).

Compost heaps in gardens depend upon a bit of all three methods with new vegetation being added to 'this year's heap' while 'last year's heap' well mixed is left to decompose under cover and to benefit from the warmth of the summer sun. It is worth remembering that the temperature in a small heap is never high enough to kill off the viruses or soil pests on diseased plants so these should not be added to the heap.

In the gardening year there is no single point at which compost is a finished product. Even when it is de-composed enough to be used on the garden there will be bits of recognisable leaves or plant stems which require further digestion by the soil micro-life.



There is a long established and thriving tradition of gardening in the city, so while the aim of this booklet is to raise awareness of the importance of gardens to wildlife, it also provides an opportunity to acknowledge some of the benefits which people gain from gardening.

Gardening is an activity which can be enjoyed by individuals alone and by families who want a shared recreation. While there is plenty of fresh air and healthy exercise involved, there is also a great deal of pleasure from the mental stimulation of planning for next year's perfect crop, deciding what to grow, then making it all possible with satisfying physical work. Vegetables grown in gardens are abundant, cheap, tasty and healthy with the excess appreciated by friends and neighbours.

Useful Sources of information

Organisations:

- FEDAGA - Federation of Edinburgh and District Garden and Allotment Associations www.fedaga.org.uk
- HDRA - Henry Doubleday Research Association www.hdra.org.uk
- LEEP www.leep.org/composting/index.html
- National Society Allotments and Leisure Gardeners www.nsalg.org.uk
- Royal Botanic Garden Edinburgh www.rbge.org.uk
- Royal Caledonian Horticultural Society www.royalcaledonianhorticulturalsociety.org
- Royal Horticultural Society www.rhs.org.uk
- RSPB - Royal Society for Protection of Birds www.rspb.org.uk/gardens
- Scottish Allotments and Gardens Society www.sags.org.uk
- Scottish Biodiversity Strategy www.biodiversityscotland.gov.uk
- Soil Association www.soilassociation.org

Websites:

- BBC Gardening www.bbc.co.uk/gardening
- Edinburgh Biodiversity Action Plan www.edinburgh.gov.uk/biodiversity
- Edinburgh in Bloom www.edinburgh.gov.uk/keepedinburghgrowing
- The Postcode Plant Database www.nhm.ac.uk/nature-online/life/plants-fungi/postcode-plants/
- Wildlife Gardening www.wildlife-gardening.co.uk

Magazines:

- Gardenlife www.gardenlifemagazine.co.uk
- Garden Answers
- Gardening Which www.which.net/gardeningwhich/
- Gardeners' World www.gardenersworld.com
- The Kitchen www.kitchengarden.co.uk
- The Scottish Garden