

**Business and nature  
working together:  
action by the forestry  
sector to protect wild  
pollinators**

# Business and nature working together: **action by the forestry sector to protect wild pollinators**

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# Business and nature working together: **Action by the forestry sector to protect wild pollinators**

## Why is this guidance needed ?

This guidance document for businesses is part of the broader implementation of the EU Pollinators Initiative<sup>1</sup>. The initiative was adopted by the European Commission (EC) on 1 June 2018, setting the framework for an integrated approach to address the decline of pollinators in the EU through three priorities:

1. Improving knowledge on the decline of pollinators, its causes and consequences;
2. Tackling the causes of such decline;
3. Raising awareness, engaging society and promoting collaboration.

One of the important actions of the initiative is to encourage and enable the business sector to take action for wild pollinators.

This document provides recommendations to the forestry sector on how to steer its activities to support wild pollinator conservation across Europe. The primary target audience are businesses higher in the forest value chain (for example, primarily manufacturers of wood products, paper industry and businesses that depend on the ecosystem services that forests deliver beyond wood – such as water companies -, etc.). However, the guidance might be just as useful for forest owners/managers, since the manufacturing businesses can promote good practices and provide advice to forest owners/managers. Its scope includes both local actions (i.e., site-specific) and measures across the value chain that can contribute towards the conservation and restoration of wild pollinator populations. The guidance document also informs businesses on the risks that stem from the decline of wild pollinators, and opportunities that arise from taking action to reverse this negative trend.

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<sup>1</sup> COM(2018) 395 final, <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1528213737113&uri=CELEX:52018DC0395>

# Summary:

Pollinators – such as bees, hoverflies, moths, butterflies and beetles – are declining dramatically around the world, and Europe is no exception. With pollinator populations being essential in underpinning the

stability of pollinator services over time, this decline of pollinators puts managed and natural ecosystems functioning at risk.

## Why should your business care ?

Managing forests adequately today is a precondition to secure sustained supply of forest resources tomorrow. Furthermore, the interest of the sector's customers (for example, retailers) in the sustainability performance of its suppliers (i.e. forestry business) is increasing as a consequence of the increased public attention to

the biodiversity and climate crises. Taking pollinator-friendly measures can therefore be used as a marketing strategy for the business. The latter can also translate into direct benefits, such as hiring and maintaining a highly-skilled workforce.

## What can your business do ?

The forestry sector is well placed to contribute towards stopping the decline of wild pollinators. Specifically, the sector can play a big role in convincing its suppliers (i.e. forest managers) to take measures directly in the forest to improve the condition of these delicate ecosystems and the services they deliver. When doing so, cooperating with NGOs and/or academics is highly recommended. It is considered a best practice to involve these expert stakeholders when drafting, implementing and evaluating actions for pollinators, whether they focus on the company's site or the supply chain.

This guidance provides recommendations for action by this business sector to protect wild pollinators illustrated with examples of companies taking the lead in creating opportunities for both the sector and pollinators. The forestry sector can:

- assist its suppliers in managing the forestry landscape to support rich biodiversity, directing them to pollinator-friendly forest management

practices such as:

- » pollinator-friendly management of forest edges and canopy-openings, creating a mix of habitats and allowing sunlight to enter the rides;
- » increasing the diversity of tree species in forests, thereby improving the health of soils;
- » maintaining a variety and good amount of dead wood habitat and veteran trees;
- » increasing landscape heterogeneity.
- monitor and evaluate the impacts of actions on wild pollinators;
- encourage sustainable pollinator management within the entire value chain;
- raise awareness of the role of pollinators and encourage stakeholders to partake in actions that promote pollinator conservation;
- partner up with NGOs, local nature authorities and/or academics when drafting, implementing and evaluating actions for pollinators, whether they focus on company's site or the supply chain.



# 1. WHAT YOU AS A BUSINESS MANAGER SHOULD KNOW ABOUT POLLINATORS

Pollinator populations are essential to underpin the stability of pollination<sup>2</sup> services in the short- and long-term. Indeed, without pollinators, a large majority of flowering plants will not be able to reproduce and eventually will decline, causing serious cascading effects across ecosystems and business value chains. Many fruits, nuts and vegetables will be lost from our diets, but also other important raw materials and products, such as vegetable oils, cotton and flax, plant-based pharmaceutical and cosmetic products. In essence, pollinators play a crucial role in maintaining terrestrial ecosystems healthy and resilient, which in turn deliver essential services to our businesses and society at large.

Pollinators – such as bees, hoverflies, moths, butterflies and beetles (Figure 1) – are declining dramatically around the world, and Europe is no exception [1, 2]. Many species are threatened with extinction creating a pollination deficit [3]. This puts managed and natural ecosystems functioning at risk, with businesses facing possible serious shortages of raw materials, a decline in crop quality and challenges with the security of the supply chain.



*Figure 1. A snapshot of the diversity of wild pollinators*

### 1.1. Pollinators and forestry

Forests and other wooded land represent 44% of the EU landmass (179 million ha). With a total annual turnover of €5 trillion euros, forests represent an important economic activity for Europe [4]. At the same time, forests provide many public goods and ecosystem services, including the conservation of biodiversity, water filtration and climate change mitigation. In the EU, nearly a quarter of the forest area is also part of the Natura 2000 network of protected areas [5].

Around 40% of the forest area in the EU is publicly owned. Public ownership of forests (Commune, Region/Province, State, etc.) is particularly prevalent in the Eastern and South-Eastern EU Member States. The average size of public forest holdings in the EU is over 1,000 ha, with considerable variations among countries [5]. Publicly owned forests are usually managed for multi-functionality, including biodiversity conservation.

<sup>2</sup> **Pollination** is the transfer of grains of pollen between flowers which enables the reproduction of flowering plants (both wild and domesticated). Without animal pollinators, many plants cannot set seed and reproduce. When humans benefit directly from this function, pollinators thereby deliver a free pollination service.

Around 40% of the forest area in the EU is publicly owned. Public ownership of forests (Commune, Region/Province, State, etc.) is particularly prevalent in the Eastern and South-Eastern EU Member States. The average size of public forest holdings in the EU is over 1,000 ha, with considerable variations among countries [5]. Publicly owned forests are usually managed for multi-functionality, including biodiversity conservation.

The other 60% of the EU's forests are privately owned by around 16 million individuals/entities. Private forest holdings have an average size of 13 ha, but most privately owned forests are smaller than 5 ha. The average size of the forest under private ownership varies considerably among Member States (0.7 – 130 ha) [5]. There is an increasing recognition of the role of forests for protection of biodiversity and of the dependency of human well-being on natural capital from forest ecosystems (See Box 1). At the same time, ecosystems, habitats and species that make up this natural capital are reported degraded or lost due to human activity [6]. 21% of the total forest resource in the EU are included in the Natura 2000 Network and more are protected for nature and biodiversity in other ways. In 2015, only 26% of forest species that are protected by the EU Habitats Directive<sup>3</sup> and 15% of the assessed forest habitats were found to be in favourable conservation status [7]. More recently, the European Red List of Trees concluded that 42% of European tree species are threatened, i.e., facing a high risk of extinction, being one of the most highly threatened groups of species that have been assessed for the European Red List so far [8]. Forestry practices are deemed one of the main causes of unfavourable and bad conservation status of forest habitats and species under the Habitats Directive [7].

## Forestry and ecosystem services<sup>4</sup>

Healthy ecosystems are the fundamental basis for a resilient society and a sustainable economy [6]. In addition to being a source of direct revenue for wood and other products (food, fuel, game, resin, cork, etc.), and hosting a significant proportion of Europe's rich biodiversity, forests provide a wealth of other important benefits to society and the economy via ecosystem services. Forests protect soil from erosion and regulate watersheds and hydrological systems by maintaining water flows. Furthermore, they regulate the local, regional and global climate, store carbon, provide habitat for pollinators, purify air and freshwater and provide us with resilience when faced with natural disasters such as avalanches, landslides, droughts and floods. They also support recreation, tourism and education. [5]

It is therefore very important that a good condition of forest ecosystems is restored and maintained. The forestry sector can contribute to this by following specific sustainable management principles and practices. Commercially managed forests sometimes require intervention to ensure the forest ecosystem remains functional. Only when these interventions really contribute to the restoration and maintenance of a good condition of the forest ecosystem, can these principles and practices be called sustainable. In Europe, the concept of Sustainable Forest Management (SFM) was defined in 1993 at the pan-European Ministerial Conference on the Protection of Forests in Europe (MCPFE) as a voluntary framework to achieve:

*«The stewardship and use of forest lands in a way and at a rate that maintains their productivity, biodiversity, regeneration capacity, vitality and their potential to fulfil now and in the future relevant ecological, economic and social functions at local, national and global levels and that does not cause damage to other ecosystems.»<sup>5</sup>*

However, the definition of SFM is rather broad, often lacking sufficient details to be systematically operationalized [9]. A more concrete and more clearly defined approach is 'close-to-nature forestry management (CTNFM)'. CTNFM is an ecosystem-based approach: it treats forest as an ecological system performing multiple functions. The main principles of CTNFM comprise the use of site adapted tree species, development of mixed and uneven-aged structurally diverse forests, avoidance of clear-felling, focus on stand stability, reliance on natural processes and focusing on development of individual trees [10].

<sup>3</sup> Among which several Lepidoptera species, that are tied to forest habitats and are in unfavourable conservation status because of the lack of open forest such as coppice or areas with willow or wet grassland.

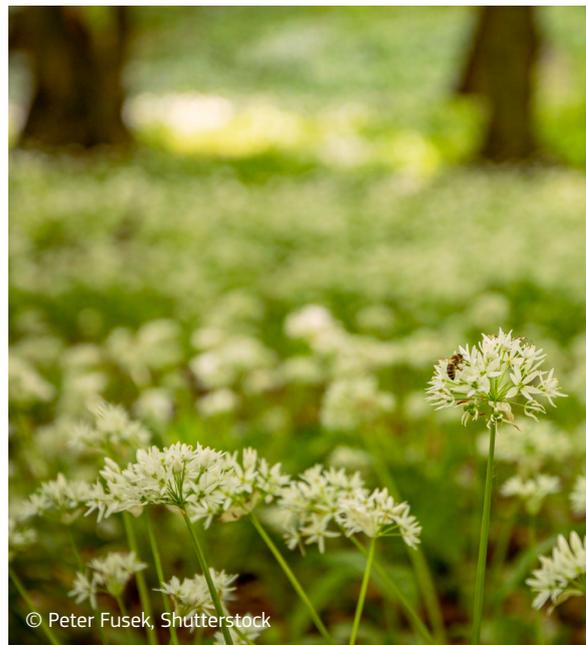
<sup>4</sup> **Ecosystem services:** the benefits to humans derived from nature, with pollination being the free service provided by wild pollinators.

<sup>5</sup> Mapping and Assessment of Ecosystems and their Services (MAES) - EU framework for ecosystem assessment; <https://biodiversity.europa.eu/maes>

<sup>6</sup> [https://ec.europa.eu/growth/sectors/raw-materials/industries/forest-based/sustainable-forest-management\\_en](https://ec.europa.eu/growth/sectors/raw-materials/industries/forest-based/sustainable-forest-management_en)

Various independent and privately-run schemes of forest certification have been developed to assess sustainable forest management at the local level. Such programmes can be of value when they are clearly and transparently backed by strong evidence from the ground on the impacts on biodiversity, including wild pollinators. Regular assessments of the sustainable management principles and practices used can help to monitor progress in restoring and maintaining a good condition of forest ecosystems.

Local NGOs, independent experts and the general public could be crucial partners to assist with this monitoring on the ground, evaluating the action plans, and verifying the performance of private certification schemes. They can help companies in defining selection criteria and setting objectives if no in-house knowledge is available, and monitor the state of wild pollinators and overall biodiversity in the forests.



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### How do pollinators benefit from forests?



The tree bumblebee (*Bombus hypnorum*) © André Karwath. CC BY-SA 2.5

Forests are a home and refuge to many pollinators, particularly forests that have diverse structures that include open areas. Forests that are managed for openness such as coppice and wood pasture and biodiverse forest edges are particularly beneficial for pollinators. In addition to nectar and pollen sources from flora and trees, pollinators find shelter and nesting habitat in open soil, sand, mud, dead wood and stumps or materials such as coarse woody debris or pithy plant stems. Additionally, tree-nesting bees such as the tree bumblebee (*Bombus hypnorum*) utilise tree holes to create their nests.

Forest edges, glades and rides are a key habitat for bees, butterflies, moths and hoverflies - providing access to sunlight and flora. Gradual forest edges have varied and ample suitable nesting opportunities for ground-nesting bees. Inside the forest, pollinators can forage on nectar-rich trees and seek protection from the weather. In fact, access to forests can be very important for pollinators of agricultural crops, with research showing that bee diversity and abundance in oilseed rape was negatively affected by distance from a forest edge [11]. Forest protection belts in agricultural land or agroforestry systems, particularly with flowering tree species, can also provide good habitats for pollinators.



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Additionally, old-growth forests are particularly important for pollinators as veteran trees provide a diverse range of nesting cavities, access to dead wood and veteran trees and the undergrowth is more fully developed which provides a vital source of diverse nectar and pollen resources.

Furthermore, even small forest fragments [12] in farmed and urban landscapes have a significant role in conserving the pollinator community, especially bees and saproxylic beetles and hoverflies. These forest fragments are most important in spring, when the herb layer provides foraging resources.

Pollinators can serve as indicators of good forest ecosystem condition which ensures sustainable delivery of multiple ecosystem services in the long-term. Their status can indicate if forest ecosystems are in a good condition and thereby signal to the forestry sector of any shortcomings in the management, and potential risks to the sustainability of the business' production chain.



## 1.2. Site and value chain impacts

Any business can be seen as a value chain as is shown in Figure 2 with environmental and social impacts occurring across its various parts.



Figure 2. Value chain link with key drivers of biodiversity loss © Arcadis Belgium

As companies are being pressed to account for those impacts, they are asking their supply chain to disclose information in order to monitor and reduce impacts. This includes keeping track of where materials come from, under what conditions they are mined or manufactured, where and how things are made, and how products are packaged, transported, used and disposed of. This information is subject to scrutiny by stakeholders, investors, regulators, and consumers alike [13].

Understanding the full environmental footprint of products has become a critical challenge for the private sector and associated players such as manufacturers and retailers. Advances in accounting and reporting methodologies enable companies to identify suppliers that perform best in relation to reducing resource dependence and environmental impacts. This, in turn, allows companies to encourage suppliers to cost-effectively manage risk and opportunity in their own supply chains and product development [13].

For the forestry sector, the value chain includes all elements leading to the production of goods (for example, wood products such as furniture, construction material, biofuels and non-wood products such as cork, nuts, berries and mushrooms) and services (for example, recreational use of forests, carbon sequestration, water regulation etc.). The value chain starts with the necessary inputs for the production process (i.e. forest management). Next, the primary products (like harvested wood and non-wood products) are transported and processed into end-market products. Depending on the product type and service, this is followed by packaging, distribution and marketing of the end-market products. Meanwhile, services are provided in a certain way (for example, transport of recreational visitors). All aspects of the value chain are important for the forestry business when identifying the full environmental footprint of the business' products and services [14].

<sup>5</sup> Ecosystem services: the benefits to humans derived from nature, with pollination being the free service provided by wild pollinators.

A close-up photograph of a common brimstone butterfly (Gonepteryx rhamni) perched on a bright yellow dandelion flower. The butterfly's wings are a pale, almost white-green color with distinct veins and a few small brown spots. The background is a soft, out-of-focus brown and green, suggesting a natural outdoor setting. The butterfly is positioned on the right side of the frame, facing left towards the flower.

## 2. WHY DO POLLINATORS MATTER TO YOUR BUSINESS?



	<b>Risks</b>	<b>Opportunities</b>
<b>Operational</b> Regular business activities, expenditures, and processes	<ul style="list-style-type: none"> <li>Degraded health/condition of forest ecosystems and the services they deliver.</li> </ul>	<ul style="list-style-type: none"> <li>Assure a good health/condition of forest ecosystems and the services they deliver. In this context, businesses should consider the trade-offs between maximising wood production through conventional forest management practices and the implementation of measures to enhance the delivery of pollination services through principles and practices aimed at restoring and maintaining them.</li> <li>Provision of other ecosystem services and associated benefits (for example, by linking water and carbon management with pollinator-friendly actions).</li> </ul>
<b>Legal and regulatory</b> Laws, public policies, and regulations that affect business performance	<ul style="list-style-type: none"> <li>New pollinator strategies<sup>7</sup> or forest, including legislative elements</li> <li>Increased compliance costs (for example, due to future ban on the use of certain pesticides).</li> <li>Unfavourable conservation status of forest habitats (Habitats Directive)</li> </ul>	Reduce compliance costs and/or other costs by: <ul style="list-style-type: none"> <li>anticipating negative impacts, for example, the use of pesticides;</li> <li>being proactive on compensation measures;</li> <li>embedding pollinator risk identification within the supply chain management and certification schemes (for example, ISO14001).</li> </ul>
<b>Financing</b> Costs of and access to capital including debt and equity	Increased financing costs (higher interest rates or harsher conditions), due to increased interest of the finance sector in how businesses in which they invest are dependent on ecosystems services such as pollination.	<ul style="list-style-type: none"> <li>Gain or maintain investor interest and confidence, which can improve access to finance and/or reduce financing costs.</li> <li>New “green funds” may become available.</li> <li>Emerging environmental markets and products may offer new revenue streams (for example, carbon offsets, habitat banking etc.).</li> </ul>
<b>Reputational and marketing</b> Company trust and relationships with direct business stakeholders	<ul style="list-style-type: none"> <li>Increased staff turnover which in turn leads to higher recruitment and retention costs.</li> <li>Reduced loyalty of key suppliers or business service providers.</li> </ul>	<ul style="list-style-type: none"> <li>Maintain a good relationship with direct business stakeholders, such as customers, suppliers and employees.</li> <li>Improve physical and mental wellbeing of employees.</li> <li>Improve ability to attract and retain employees.</li> <li>Growing demand for credibly certified products (for example, pollinator-friendly production labels). Labels and certification might recognise the bee-friendly production process in their certification requirements in the future.</li> <li>Differentiating the business to key customers who demand strong sustainability commitments in an increasingly competitive market.</li> </ul>
<b>Societal</b> Relationships with the wider society	Local communities may hold the agri-food and beverage sector responsible for the decline of wild pollinators and the loss of benefits they provide to the society.	Local communities may benefit from other improved ecosystem services that come along with the implementation of pollinator-friendly measures, for example, through improved recreational access to green areas, cleaner air and improved regulation of water flows.

*Table 1. WHY pollinating insects matter to your business and WHAT to do (risks & opportunities for the agri-food and beverage sector that are of key importance and sector-specific are highlighted in green).*

<sup>7</sup>Promote Pollinators, Coalition of the Willing on pollinators (<https://promotepollinators.org/>)



### 3. WHAT CAN YOUR BUSINESS DO?

The forestry sector is well placed to contribute towards reversing the decline of wild pollinators. Specifically, the sector can play a big role in convincing its suppliers (i.e. forest managers) to implement measures directly in the forest to improve the condition of the forests ecosystem and the services they deliver. When doing so, cooperating with NGOs and/or academics is highly recommended. It is considered a best practice to involve these expert stakeholders when drafting, implementing and evaluating actions for pollinators, whether they focus on the company's site or the supply chain.

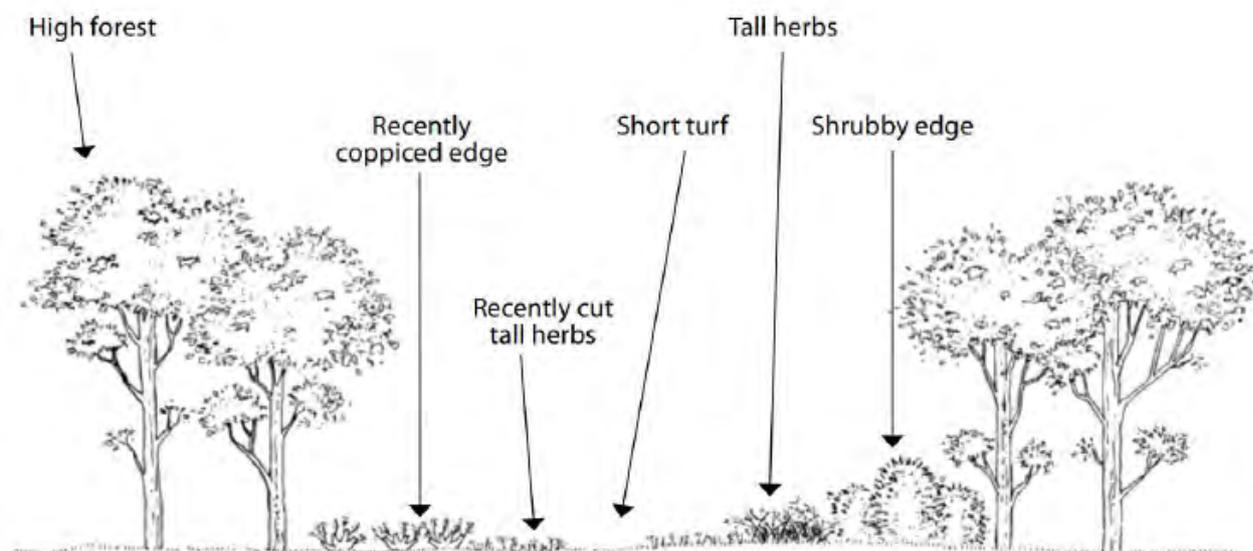
### 3.1. Value chain actions

**Assist suppliers in managing the forest landscape to support rich biodiversity.** The following elements are key in pollinator-friendly forest management:

#### Forest edges and canopy-openings

A growing body of knowledge<sup>8</sup> shows that pollinators use recently disturbed areas such as burns, windfalls or timber harvests for foraging and/or nesting. Additionally, open areas with full sunlight [12] [15], including **recent coppiced areas, meadows, grasslands and pastures and biodiverse forest edges can provide habitat for many threatened butterflies and moths, hoverflies, beetles and other pollinator species** [16, 17], especially if there are suitable plant forage and nesting opportunities. East and south-facing edges, which get first sun and warm up early in the morning are useful to the many pollinators that forage early in the day. These edges also tend to provide better shelter from the prevailing wind (wind can significantly reduce foraging activity). Shady north-facing edges can be useful to pollinators during droughts or hot periods [18].

Isolated open areas surrounded by dense woodland can be difficult for pollinators to access. Pollinator-friendly management of tracks and rides<sup>9</sup> links these areas to each other and helps to connect isolated habitats.



Reference: Blakesley, D and Buckley, GP. 2010. *Managing your woodland for wildlife*. Pisces Publications, Newbury. Artist: Tharada Blakesley <https://www.woodlands.co.uk/owning-a-wood/managing-your-woodland-for-wildlife/O2-introduction.pdf>

<sup>8</sup> [https://oregonforests.org/sites/default/files/2018-01/WIMF\\_data\\_Pollinators\\_web.pdf](https://oregonforests.org/sites/default/files/2018-01/WIMF_data_Pollinators_web.pdf)

<sup>9</sup> Most commonly rides consist of a central grass zone with a mixed herbaceous and shrub zone on one or both sides. A path or track becomes a ride when it is wide enough for there to be a gap in the canopy above the ride which allows sunlight to reach the ground.

The best rides for pollinators have a mix of habitats; with bare ground in the middle flanked by grassland or heathland, then scrub and tall herbs, and finally trees. In order to create and maintain biodiversity, active management may be required in forests where there is an overabundance or a lack of naturally occurring herbivores [19]. The central zone, receiving the most sunlight, can be mown annually in case access is required, the second, herbaceous zone should be mown on a 3-5 year cycle, and the shrub zone, which is transitional between the trees and the open area, should be cut on an 8-20 year rotation [20]. Managing rides (both cutting of woody material and mowing of grassland areas) in rotation and in relatively short sections at a time will produce more diverse conditions and ensure that woody species do not shade out other habitats<sup>10</sup>. It is recommended to monitor regularly whether human intervention is needed.



### Diverse forest stands (mixed forests)

Dense conifer woodlands have limited value for pollinators. Woodlands that have a diverse structure are of greater value for pollinators as they provide an area for basking in the sun and nectar sources by giving flora a chance to colonise. If a woodland lacks spring blossoming trees and shrubs, it is recommended to promote the growth of these at the edges of rides and clearings or along sunny woodland margins [18].

A good practice is to **increase the diversity of tree species in the forests**, to increase biodiversity benefits and resilience, in particular by **improving the health of soils** through mineral deposition. One interesting example is agro-forestry, a practice that involves land-use systems and technologies where trees are integrated on the same land together with crops and/or animals and that maximises the use of sunlight and other resources, maintains and improves soil fertility and structure, also modifying the microclimate for crops [21].

Another opportunity lies in contributing to regulate the pesticide exposure of crops. The forestry sector is well positioned to encourage its suppliers and neighbouring farmers to decrease the use of pesticides. One way to do this is by encouraging the adoption of integrated pest management practices that only apply pesticides when pest pressure reaches an economic threshold [22].

<sup>10</sup> [https://cdn.buglife.org.uk/2019/07/Woodland-Pollinator-Sheet-Final\\_0.pdf](https://cdn.buglife.org.uk/2019/07/Woodland-Pollinator-Sheet-Final_0.pdf)

When planting as part of forest management practices, it is important to give priority to native planting stocks and seeds that are best sourced from local producers and horticulturalists [24]. Native species receive a greater number of visits from pollinators, even from the more generalist species (i.e. pollinators that feed on many species of plants). They are more resilient since they have adapted to local climate and soil conditions. They provide both adult and larval food sources and they do not require fertilizer [23]. Also important to know is that invasive alien plant species, such as Himalayan Balsam (*Impatiens glandulifera*) or Tree of Heaven (*Ailanthus altissima*) can be highly attractive to pollinators. However, they are displacing native vegetation that is important for pollinators and for many other insects and wildlife, so their overall impact on biodiversity is negative. Removing invasive species<sup>11</sup> from forests is very important, as much as to not introduce them through planting, especially when seeking more sustainable forest management. Information about indigenous plants can be acquired from local botanical associations, ecologists or NGOs active in nature conservation



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### Veteran trees and deadwood

**Maintaining a variety and good amount of dead wood habitat and veteran trees**, both naturally occurring and from spare wood from felling, is important for the conservation of hoverfly species that depend on dead wood for reproduction [12].

### Landscape heterogeneity (diversity of habitats):

Landscape heterogeneity often has a positive effect on biodiversity. Several studies have shown that **pollinator diversity is higher in complex landscapes** than in structurally simple ones [25, 26], because many species depend on complementary resources from different habitats, such as feeding or nesting sites [27] and the heterogeneity of cover types increases the number of habitats and microhabitats available for different pollinators [25]. To reach landscape heterogeneity, all three of the previous mentioned elements are crucial. Furthermore, wider biodiversity should always be considered when deciding on which actions to take, especially when dealing with sensitive issues like clear-cuts. Clear-cuts might help some pollinator populations in the short-term, but in general can bear negative effects for wider biodiversity.

Companies in the forestry sector should take steps to convince its supply chain (i.e. forest managers) to switch to pollinator-friendly forestry management practices and principles as described above, in order to diversify forest ecosystems and increase habitat heterogeneity. They can determine if their suppliers are taking appropriate measures for maintaining or restoring wild pollinator populations and assist them with managing their impacts. The business sector can reward suppliers for good practices, for example by offering suppliers long-term contracts tied to commitments to deliver richer biodiversity in their forests and providing diversity of habitats for pollinators. Long-term contracts enable suppliers to invest in long-term measures which is crucial to reverse the negative trends of pollinator populations.

For forest owners and managers, the EU Common Agricultural Policy can also provide support for pollinator-friendly forest management. Beyond the establishment of diverse forests or other wooded areas, including agroforestry systems, creation of biodiverse, pollinator-friendly forest edges or introducing native forest fruit species to existing forest stands can also be supported<sup>12</sup>. Businesses in the forestry sector should advise suppliers to apply for such CAP funding.

<sup>11</sup> See also 'Managing invasive alien species to protect wild pollinators', technical guidance prepared by IUCN (2019) for the European Commission.

## Monitor and evaluate the impacts of your actions on wild pollinators

In order to assess the impacts of any taken action to protect wild pollinators, it is fundamental that businesses ensure systematic monitoring of the impacts of such measures. This will allow the companies to track the extent to which their goals were achieved, while gaining invaluable insight on how to improve future actions. Monitoring can be also a valuable management tool for project managers to track progress towards achieving outputs: planned activities and set milestones across a value chain.

In order for business' efforts to be recognized by your stakeholders, local NGOs, ecologists or academic experts could be crucial partners to assist with the monitoring of the efforts on the ground and with the evaluation of action plans. They can also help with the design of conservation measures and strategies if no in-house knowledge is available.

### Encourage the entire value chain to act

Environmentally-friendly value chain solutions can help companies to improve corporate image, employee satisfaction, customer loyalty/satisfaction and better relations with stakeholders, while positively impacting overall biodiversity and ecosystem services.



In order to make a value chain environmentally-friendly, it is necessary to consider all activities in the value chain such as design, supply, production, assembly, packaging, logistics, distribution, marketing, after-sales and appropriate product disposal.

Improving the value chain performance with environmentally-friendly solutions will result in the reduction of energy consumption, environmental accidents, air emission, waste, etc. Companies should ensure that its products and operations cause the least damage to the environment during the whole product's life cycle via green purchasing, green design, internal environmental management, green production, environmentally-friendly packaging and transportation. Reverse logistics activities such as reuse, remanufacture and recycle that are used at the end of product's life cycle contribute to the sustainability of products [28].

To reinforce efforts like these, companies should monitor suppliers' sustainability performance and hold them accountable for it. Once companies know where their supply-chain issues are, they can set goals for lessening their impact. Ultimately, consumer-based companies can only achieve ambitious sustainability goals if they set high standards for their suppliers' performance and stop doing business with suppliers that fall short.

### Increase overall awareness and knowledge

The forestry sector can (co-)develop research to increase the knowledge on the relationship between pollinators and forest management practices, for example, the relationship between the amount of veteran trees and deadwood in forest fragments and the abundance of cavity-nesting bees and saproxylic hoverflies, introduction of trees with different flowering periods, particularly forest fruit trees. Other research areas to develop can look to improve the efficacy of pest management in pesticide-free forestry management systems [22].

More general awareness raising measures towards the local community can be found in Chapter 3.2.

<sup>12</sup> [https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/rural-development\\_en](https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/rural-development_en)

### 3.2. Site/local level actions

While the previous chapter focused on sector-specific actions, this last chapter gives an overview of measures that can be applied to all business sectors, since they target individual business locations (for example, the premises of a business' headquarters or an industrial facility), as well as the company's properties that have not yet been developed for business purposes.

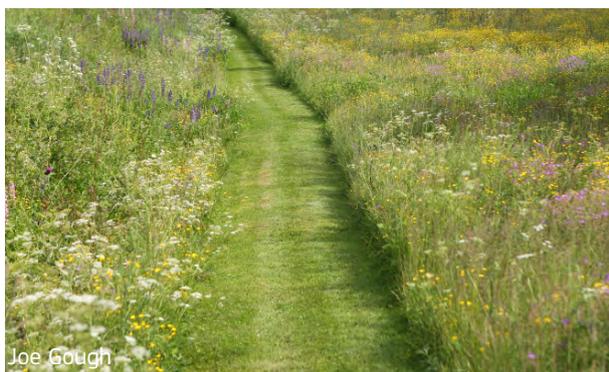
#### Action within companies' grounds

Businesses can draw up a long-term action plan, alongside a management plan, that identifies and protects the areas on the company's premises that are already providing food (for example, patches of wildflowers, weeds or flowering hedgerows) and shelter (like bare soil, long grass and dry-stone walls) for wild pollinators. In order to ensure pollinator-friendly management, the following actions are key:



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- Reduce mowing frequency to create species-rich grasslands. Natural habitats can be further supplemented by artificial ones (for instance, bee hotels).
- When planting for pollinators, use native species (like seed mixes, clovers, bulbs, trees and shrubs). Ensure that wild pollinators have foraging resources during the whole vegetation season.
- Ensure connectivity with surrounding areas of green infrastructure and nature importance by creating grasslands and other types of vegetation that support rich biodiversity.
- Avoid and control the spread of invasive alien species<sup>13</sup>, both plants and animals.
- Consider the construction of green roofs and walls<sup>14</sup>, as they can provide considerable feeding ground for wild pollinators.
- Reduce light pollution, as artificial light can negatively affect insect populations.
- Adopt a pollinator-friendly management protocol and do not use pesticides (insecticides, fungicides and herbicides), as these can be harmful to wild pollinators.
- Ensure contractors that manage the company's land are aware of the company's intentions to enhance wild pollinators and how this should be realised.



Joe Cough

It is recommended that businesses partner with local NGOs/authorities or experts to include biodiversity and ecosystem services at the design stage of the company's site. They can also help with development of key performance indicators (KPIs) and, as it was already mentioned, with monitoring, reporting and evaluation of outcomes. The company could, for example, monitor the presence and diversity of local pollinator species at the company's site and the wider environment either through local partnerships or by engaging in local citizen science programmes<sup>15</sup>.

These actions within the companies' grounds can benefit wild pollinators and overall biodiversity most when they are applied early in the design stage of the company's site when the landscaping and infrastructure features are still open for creativity. **When securing habitats for wild pollinators, the main guiding principle is to let nature regenerate on its own.** This can be complemented by additional planting of native flowers seed mixes, if/when needed

<sup>13</sup> See also 'Managing invasive alien species to protect wild pollinators', technical guidance prepared by IUCN (2019) for the European Commission.

<sup>14</sup> See also 'A guide for pollinator-friendly cities: How can spatial planners and land-use managers create favourable urban environments for pollinators?' by Wil et al. (2019), guidance prepared by ICLEI Europe for the European Commission.

<sup>15</sup> Reference to Citizens for pollinator conservation guidance

## Generic actions which do not require any land holding

It is recommended for businesses to embed pollinator-friendly actions into the company's strategy and daily operations:

- Integrate pollinator-sensitive practices into the company's environmental management system and/or other certification schemes or standards.
- Introduce internal biodiversity policy commitments that include measures to improve pollination. For example, by implementing a biodiversity- or pollinator-friendly purchasing policy, the business can direct its suppliers to reduce the negative impacts on pollinators.
- Link the business' strategy to national and international biodiversity policy (including the EU Pollinators Initiative) and to the SDGs<sup>16</sup> (namely SDG 15 "Life on Land", SDG 2 "Zero hunger" and SDG 12 "Responsible consumption and production").



In addition, the company can invest in projects to restore, create and connect pollinator habitats to reduce the environmental footprint of their buildings and operations and obtain general environmental benefits (reduced solid waste and wastewater, less pollution, energy efficiency etc.) and implement green procurement. Overall, these improvements will benefit nature and wild pollinators alike.

Also, the company can take efforts to **raise awareness** of:

- **the local community:** sponsor creation/restoration of pollinator habitats or arrange an expert to give a training/lecture on the conservation of wild pollinators;
- **the business' workplace:**
  - » organise pollinator awareness training sessions or workshops for employees (for example, on how to ensure their own gardens are pollinator-friendly, or how to observe and record wild pollinators in order to help monitoring efforts);
  - » include environmental considerations at each stage of the procurement process of goods, services and works (i.e. green procurement);
- **the business sector:** share your experiences regarding the implementation of pollinator-friendly measures with the EU Business @ Biodiversity Platform at relevant conferences or seminars, and/or through social media using the #EUPollinators.



**Business @  
Biodiversity**

<sup>16</sup> <https://sdgs.un.org/goals>



## 4. WHAT ARE FRONT-RUNNERS ALREADY DOING?

This section presents a limited, non-exhaustive set of examples of businesses taking action for pollinators, to illustrate the diversity of potential actions that could be uptaken by the forestry sector. The list has been generated by consulting the members of the EU Business and Biodiversity Platform<sup>17</sup>, and through literature review.

### Österreichische Bundesforste ÖBf (Austria State Forest Agency)

**Company:** The Austria State Forest management agency (Österreichische Bundesforste ÖBf) manages a tenth of the total forested area of Austria.

**Action:** ÖBf launched the initiative 'Aktiv für Wildbienen' (Active for wild bees) in 2016 in collaboration with the NGO Naturschutzbund. The initiative was a response to a national study that highlighted the precarious situation of wild bees in Austrian forests (Schwarzl & Sedy 2015). As part of the «Active for wild bees» project, experts in seven ÖBf forest operations surveyed wild bee populations in selected areas and proposed measures to improve the state of wild pollinators. The ÖBf implemented these measures in order to ensure the persistence of wild bee species in the area.

The project team has developed management plans and provided practical advice on how to promote wild bee populations in different forest habitats and landscapes (Martina Schwantzer personal communication; ÖBf 2017). They have produced a forest management guidebook (Naturschutzpraxisbuch) with a section dedicated to wild bees in forests (ÖBf 2017). The guidebook is aimed at all forest managers and has been implemented across the whole state forest area, including to the 50% that is subject to nature protection regulations (Natura 2000 and/or other protection status). Implementation is guided by the regional nature area managers, and regularly controlled.

In addition, the NGO Naturschutzbund Österreich and the ÖBf are organising educational activities about wild bees in state forest areas. For example, schoolchildren helped restore a wildflower meadow for wild bees in the state forest Traun-Innviertel in spring 2018.

#### More info:

<https://www.bundesforste.at/die-bundesforste/naturschutz/projekte-kooperationen/naturschutzprojekte/wildbienen.html>

<https://www.bundesforste.at/die-bundesforste/naturschutz/projekte-kooperationen/kooperationen/naturschutzbund.html>

Schwarzl, B. & Sedy, K. (2015). Wildbienenparadies Österreich? Available at: [https://www.bundesforste.at/uploads/publikationen/Studie\\_Wildbienenparadies\\_OEsterreich\\_Aktuelle\\_Umweltsituation\\_im\\_Wald.pdf](https://www.bundesforste.at/uploads/publikationen/Studie_Wildbienenparadies_OEsterreich_Aktuelle_Umweltsituation_im_Wald.pdf)

Österreichische Bundesforste (2017). Naturschutzpraxisbuch. Available at: <https://www.bundesforste.at/fileadmin/naturraummanagement/Naturschutz/OEBf-Naturschutzpraxisbuch.pdf>

### Corticeira Amorim, Portugal

**Company:** Corticeira Amorim is a Portuguese holding company that is in the cork business since 1870. Today it is one of the leaders in the sector worldwide.

Cork is 100% natural and environmentally friendly. The raw material is fully biodegradable and can easily be recycled without producing toxic waste. Cork oak (*Quercus suber*) forests are ecosystems of high ecological value, both at the socioeconomic and environmental level. This ecosystem is highly biodiverse, including various species of bees and butterflies and threatened species such as the emblematic Iberian lynx (*Lynx pardinus*) and Iberian Imperial Eagle (*Aquila adalberti*).

<sup>17</sup> [https://ec.europa.eu/environment/biodiversity/business/index\\_en.htm](https://ec.europa.eu/environment/biodiversity/business/index_en.htm)

It also provides society with countless services, ranging from regulation of the climate and water cycles to protection against erosion and wildfires, carbon sequestration, cultural services such as open-air leisure activities, cork and firewood production, and cattle rearing. The cork oak lives for 200 years on average, during which it may be harvested between 15 to 18 times (typically every 12 years).

**Action:**

Corticeira Amorim is conscious of its role in maintaining the viability of cork oak forests and considers their preservation a strategic priority. By taking action to protect the ecosystem as a whole, their actions indirectly also benefits wild pollinator populations. The company's contribution to the maintenance, conservation and enhancement of the cork oak forest is based on the following guidelines:

- Expand knowledge about the environmental impact of cork products and the ecosystem they support;
- Promote cork-based products and the sustainable management of the cork oak forest as safeguards of the ecosystem;
- Proactive discussion of policies and proposals of measures to protect the cork oak and to conserve cork oak forests, as well as promoting the cork sector, the certification of forest management systems and remuneration of the environmental benefits of cork oak forests.

Together with the European Cork Confederation - C. E. Liège, Corticeira Amorim carried out a study to describe the value of cork oak forest ecosystem services at a local scale. The study examined the Herdade da Machoqueira do Grou, a 2,423 hectare property with various land uses, including around 1,000 hectares of cork oak forests. The study highlighted the fundamental role of cork oak forests in the different ecosystem services examined, in particular as compared to other soil uses. An output of the study also provided forest owners with a wide range of practical information on the effects of management practices on ecosystem services.

Furthermore, from 2014 to 2018, Corticeira Amorim (Amorim Florestal) joined a consortium with Centre Tecnològic Forestal de Catalunya (Forestry Technological Centre of Catalonia), Forestal Catalana SA and the Forestry Ownership Centre of Catalonia, in a 4-year LIFE+ SUBER Project. The project aimed to implement and demonstrate new forest management techniques for European cork oak forests, in order to improve their adaptation and resilience to climate change and to enhance their conservation and management prospects. The team produced various tools to integrate climate change adaptation into forestry policy and the cork subsector regulations, including a guide with recommendations and measures for cork oak forests to adapt to climate change and a GIS (Geographic Information System) application with 3 climate vulnerability maps.

In partnership with AFN (the Portuguese National Forestry Authority), ICNB (Institute for Nature Conservation and Biodiversity), Quercus (a Portuguese NGO) and WWF, Corticeira Amorim also signed an agreement to support research, development and innovation that could enhance the value and the sustainability of the cork oak forests and associated biodiversity. Being part of such a partnership allows the company to protect their own intellectual property and co-decide on the research priorities within this field. The partnership has been awarding research funding since 2008<sup>18</sup>.

Furthermore, the company organises volunteering tree planting projects for its employees. Since 2001, Corticeira Amorim's employees have planted over 20,000 native tree species.

**More info:**

<https://www.amorimcork.com/>

<https://www.amorim.com/en/whats-new/news/Study-by-CORTICEIRA-AMORIM-and-CE-LIEGE-quantifies-ecosystem-services/1651/>

<https://www.amorim.com/en/whats-new/news/Volunteers-from-Corticeira-Amorim-plant-2000-cork-oak-trees-in-Ponte-de-Sor/1847/>

<http://lifesuber.eu/en/>

[https://www.amorim.com/xms/files/Sustentabilidade/Relatorios/2008\\_Relatorio\\_Sustentabilidade\\_Amorim\\_Ing\\_2008\\_Bookmarks.pdf](https://www.amorim.com/xms/files/Sustentabilidade/Relatorios/2008_Relatorio_Sustentabilidade_Amorim_Ing_2008_Bookmarks.pdf)

<sup>18</sup> [https://www.amorim.com/xms/files/Sustentabilidade/Relatorios/2008\\_Relatorio\\_Sustentabilidade\\_Amorim\\_Ing\\_2008\\_Bookmarks.pdf](https://www.amorim.com/xms/files/Sustentabilidade/Relatorios/2008_Relatorio_Sustentabilidade_Amorim_Ing_2008_Bookmarks.pdf)

## Bayerische Staatsforsten (State Forest of Bavaria) - Fichtelberg

**Company:** The Bayerische Staatsforsten was founded in 2005 as an institution under public law. Its mission is the sustainable management of the Bavarian state forest. With around 2,700 employees, they manage the entire Bavarian state forest, a total of 808,000 hectares. 6.1 million m<sup>3</sup> of wood grow on this area every year, of which almost 5.2 million m<sup>3</sup> are used sustainably.

### Action:

In order to increase the range of flowering areas for native insect species in the state forests, the project «Der Wald blüht auf» (The forest is blooming) was launched:

- The forest agency create many small flowering meadows of locally adapted, autochthonous plant species in the state forest as a new habitat for insects.
- Foresters specifically selected forest meadows, roadsides and former wood storage areas that were previously mainly covered with grasses.
- As there are no special flowering seed mixtures for the forest, they are created in cooperation with the Bavarian State Institute for Viticulture and Horticulture (LWG) and seed growers, further examined and optimized for the special forest needs.

In the Fichtelberg forest operation alone, the Bavarian State Forests created around 30,000 m<sup>2</sup> of flower strips with local flowering plants in 2018.

In addition, the Bavarian State Forests works together with the three major Bavarian beekeeping associations to support the bees in Bavaria.



### More info:

<https://www.baysf.de/de/magazin/der-wald-blueht-auf.html>



## 5. FURTHER READING

#### EU Pollinators Initiative:

- <https://ec.europa.eu/environment/nature/conservation/species/pollinators>
- EU Pollinator Information Hive: <https://wikis.ec.europa.eu/display/EUPKH/EU+Pollinator+Information+Hive>
- [https://ec.europa.eu/environment/biodiversity/business/news-and-events/news/news-84\\_en.htm](https://ec.europa.eu/environment/biodiversity/business/news-and-events/news/news-84_en.htm)

#### IPBES reports:

- <https://ipbes.net/global-assessment-report-biodiversity-ecosystem-services>
- <https://ipbes.net/assessment-reports/pollinators>

IUCN. 2019. Managing invasive alien species to protect wild pollinators. Technical guidance prepared for the European Commission under contract No 07.0202/2018/795538/SER/ENV.D.2 “Technical support related to the implementation of the EU Pollinators Initiative”.

Potts, S. G., Imperatriz-Fonseca, V., Ngo, H. T., Aizen, M. A., Biesmeijer, J. C., Breeze, T. D. et al. (2016). Safeguarding pollinators and their values to human well-being. *Nature*, 540(7632), 220–229. <https://doi.org/10.1038/nature20588>  
Barredo, J., et al. 2015. Mapping and assessment of forest ecosystems and their services – Applications and guidance for decision making in the framework of MAES.

Buglife. Managing woodland for pollinators. [https://cdn.buglife.org.uk/2019/07/Woodland-Pollinator-Sheet-Final\\_0.pdf](https://cdn.buglife.org.uk/2019/07/Woodland-Pollinator-Sheet-Final_0.pdf)

Clarke, S.A., Green, D.G., Bourn, N.A. & Hoare, D.J. (2011). Woodland management for butterflies and moths: a best practice guide. [https://butterfly-conservation.org/sites/default/files/woodland\\_management\\_for\\_butterflies\\_managingwoodland.pdf](https://butterfly-conservation.org/sites/default/files/woodland_management_for_butterflies_managingwoodland.pdf)

Department for Environment Food & Rural Affairs. Woodland – tailored advice on managing land for pollinators. [https://www.bumblebeeconservation.org/wp-content/uploads/2018/03/6192\\_defra\\_info\\_sheet\\_woodlands\\_final.pdf](https://www.bumblebeeconservation.org/wp-content/uploads/2018/03/6192_defra_info_sheet_woodlands_final.pdf)

Keenleyside, C. 2020. A guide to pollinator-friendly farming. Guidance prepared by the Institute for European Environmental Policy for the European Commission under contract No 07.0202/2018/795538/SER/ENV.D.2 “Technical support related to the implementation of the EU Pollinators Initiative”.

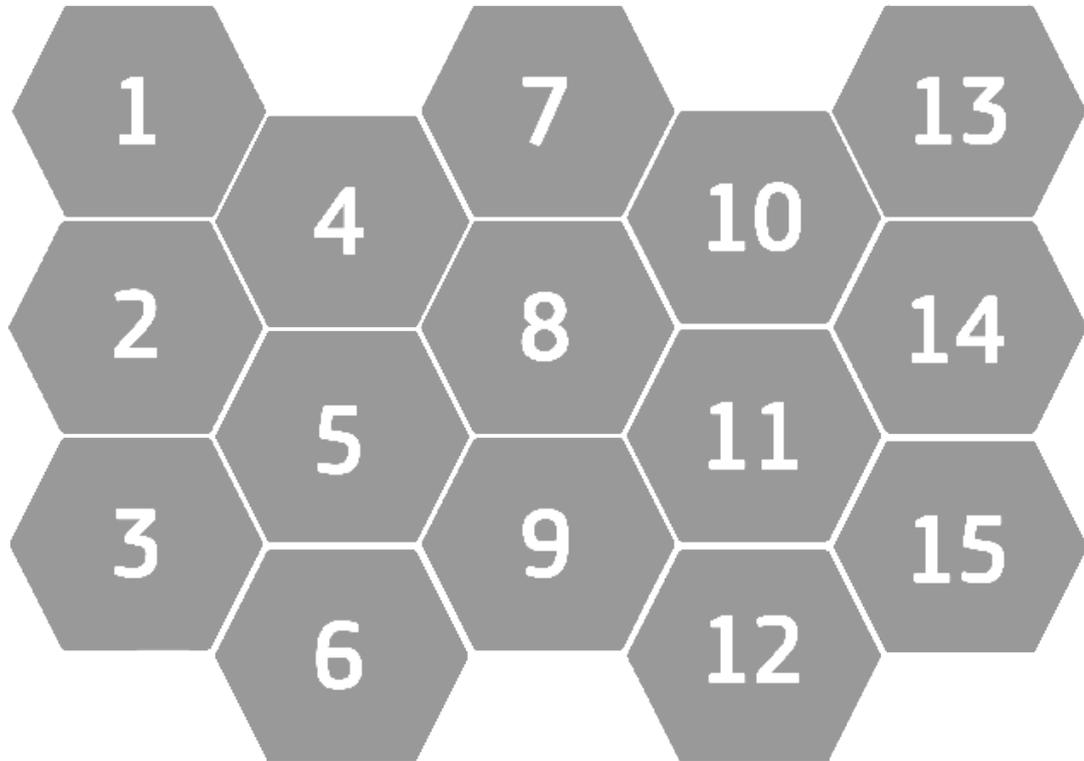
Wilk, B., Rebollo, V., Hanania, S. 2019. A guide for pollinator-friendly cities: How can spatial planners and land-use managers create favourable urban environments for pollinators? Guidance prepared by ICLEI Europe for the European Commission.

## References

1. Goulson, D., et al., Bee declines driven by combined stress from parasites, pesticides, and lack of flowers. *Science*, 2015. **347**(6229).
2. Hallmann, C.A., et al., More than 75 percent decline over 27 years in total flying insect biomass in protected areas *PLOS ONE*, 2017. **12**(10): p. e0185809.
3. UNEP-WCMC, The pollination deficit: towards supply chain resilience in the face of pollinator decline. 2018, University of Cambridge Institute for Sustainability Leadership, Fauna & Flora International, University of East Anglia, & UNEP-WCMC: Cambridge, UK. p. 42.
4. Von Croy, H. The main challenges for the future of forest management in the EU. *CountrySide*, 2018.
5. Union, E., Natura 2000 and forests, Part I-II., in European Commission Technical Report No. 2015-088. 2015: Luxembourg, Office for Official Publications of the European Communities. p. 108.
6. Barredo, J., et al., Mapping and assessment of forest ecosystems and their services – Applications and guidance for decision making in the framework of MAES. 2015.
7. EEA State of nature in the EU: results from reporting under the nature directives 2007-2012. 2015.
8. Rivers, M., et al., European Red List of Trees. 2019, IUCN: Cambridge, UK and Brussels, Belgium.
9. MacDicken, K.G., et al., Global progress toward sustainable forest management. *Forest Ecology and Management*, 2015. **352**: p. 47-56.
10. Bauhus, J., K. Puettmann, and C. Kühne, Close-to-Nature Forest Management in Europe: Does It Support Complexity and Adaptability of Forest Ecosystems. 2013. p. 187-213.
11. Bailey, S., et al. Distance from forest edge affects bee pollinators in oilseed rape fields. 2014.
12. Proesmans, W., et al., Importance of forest fragments as pollinator habitat varies with season and guild. *Basic and Applied Ecology*, 2018.
13. Makower, J., State of Green Business. 2013, GreenBiz.com. p. GreenBiz.com.
14. Fernandez-Stark, K. and P. Bamber, Inclusion of Small and Medium Producers in the Value Chain: Assessment of Five High-Value Agricultural Inclusive Business Projects in Latin America. 2012.
15. Nyoka, S., Effects of Fuel-Reduction Treatments on Pollinators in a Pinyon-Juniper Woodland (Arizona). *Ecological Restoration*, 2010. **28**.
16. Gikungu, M., et al., Bee diversity along a forest regeneration gradient in Western Kenya. *Journal of Apicultural Research*, 2011. **50**: p. 22-34.
17. Taki, H., et al., Succession Influences Wild Bees in a Temperate Forest Landscape: The Value of Early Successional Stages in Naturally Regenerated and Planted Forests. *PloS one*, 2013. **8**: p. e56678.
18. Buglife Managing woodland for pollinators. unknown.
19. Clarke, S.A., et al., Woodland management for butterflies and moths: a best practice guide. 2011, Butterfly Conservation UK.
20. Affairs, D.f.E.F.R. Woodland - Tailored advice on managing land for pollinators. unknown.
21. Torralba, M., et al., Do European agroforestry systems enhance biodiversity and ecosystem services? A meta-analysis. *Agriculture, Ecosystems & Environment*, 2016. **230**: p. 150-161.
22. Potts, S.G., et al., Safeguarding pollinators and their values to human well-being. *Nature*, 2016. **540**(7632): p. 220-229.
23. Salisbury, A., et al., EDITOR'S CHOICE: Enhancing gardens as habitats for flower-visiting aerial insects (pollinators): should we plant native or exotic species? *Journal of Applied Ecology*, 2015. **52**(5): p. 1156-1164.
24. Councils: actions to help pollinators., in All-Ireland Pollinator Plan 2015-2020. 2016, National Biodiversity Data Centre: Waterford.
25. Holzschuh, A., I. Steffan-Dewenter, and T. Tscharntke, Agricultural landscapes with organic crops support higher pollinator diversity. *Oikos*, 2008. **117**(3): p. 354-361.

26. Batáry, P., et al., Landscape-moderated biodiversity effects of agri-environmental management: a meta-analysis. *Proceedings of the Royal Society B: Biological Sciences*, 2011. **278**(1713): p. 1894-1902.
27. Lázaro, A. and D. Alomar, Landscape heterogeneity increases the spatial stability of pollination services to almond trees through the stability of pollinator visits. *Agriculture, Ecosystems & Environment*, 2019. **279**: p. 149-155.
28. Sezen, B. and S. Çankaya, Green supply chain management theory and practices. 2016. p. 92-114.

# Annex I



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