



WHITE PAPER SEMPERGREEN®

BUILDING FOR BIODIVERSITY

How green roofs can contribute
to biodiversity in cities

June 2021



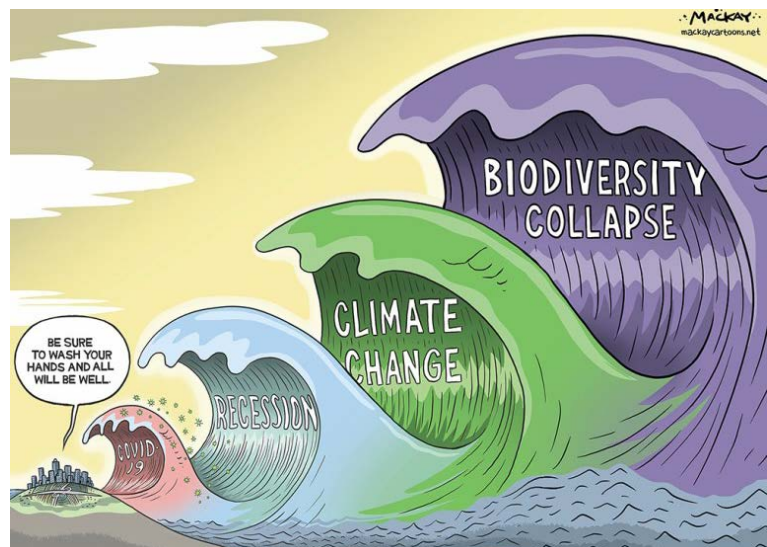
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A densely populated city with skyscrapers, situated near a tempestuous sea. A voice rises from the city: “Be sure to wash your hands and all will be well”. The speaker doesn’t seem to realise that four giant tidal waves are heading for the city. The first wave that will hit the city bears the heading Covid-19. This tidal wave is relatively small, just twice the height of the skyscrapers. Unfortunately, this is not the only wave ready to crash down on the city and certainly not the biggest. Shortly afterwards Recession, Climate Change and Biodiversity Collapse will follow. Each tsunami bigger and more threatening than the first. This powerful imagery by cartoonist Graeme MacKay speaks volumes.¹ After the corona crisis, there are still several tough challenges waiting for us that have a huge impact on humanity, such as biodiversity loss. And this raises the question: what will be left of the city after the last tidal wave?

The cartoon says it all. Biodiversity is doing very badly. On a global scale around 1 million plant- and animal species are threatened with extinction, and numbers are steadily dropping everywhere.² According to the Netherlands Environmental Assessment Agency (PBL), in the year 1900 the percentage of Global Mean Species Abundance* was still around 90%. Now it has dropped to only 70%. Things are even worse in Europe, where the numbers dropped from 75% to 40%.³ In order to prevent biodiversity from shrinking even further, we’ll have to take action together... before it’s too late.



Source: Graeme MacKay¹

BE PART OF THE SOLUTION, NOT THE PROBLEM

The loss in biodiversity is mainly due to the fact that more and more nature is being exchanged for housing, industrial estates and agricultural areas. That is why one of the solutions to improve biodiversity is the greening of urban areas through the means of green roofs. Architects, project developers, city planners, building owners and municipalities, can become part of the solution instead of the problem. The global population is still increasing, resulting in housing crises and the need to build more affordable homes in the next decades.⁴ This is the perfect opportunity to build (and rebuild) cities in a nature-inclusive way and make a significant contribution to promoting biodiversity while solving the housing crisis.

*The Mean Species Abundance (MSA) metric is an indicator of local biodiversity intactness.



THE IMPORTANCE OF BIODIVERSITY

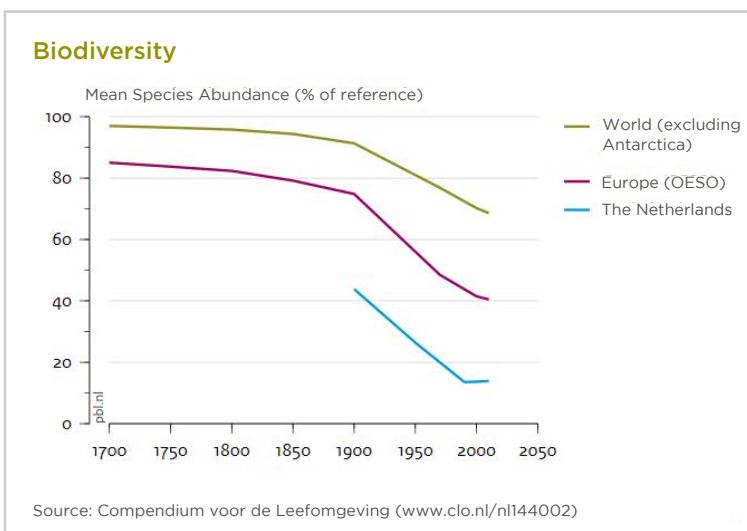
But what makes biodiversity so important? The fact that humanity cannot survive without it. All life is connected. As woo-woo as this may sound, plants, animals and also we as humans lean on each other to survive. The disappearance of plant and animal species causes ecosystems to collapse. This, in turn, has a huge impact on the rest of life on earth. Picture dominoes toppling over one after another. Direct consequences of this happening could be sudden changes in the environment, such as the collapse of fish stocks, drought, the outbreak of forest fires and diseases. Some of these things are happening already. Just think about the increasingly devastating forest fires in many countries, dying coral reefs, and the COVID-19 pandemic.

WHAT IS BIODIVERSITY?

“Biodiversity, also called biological diversity, the variety of life found in a place on Earth or, often, the total variety of life on Earth. A common measure of this variety, called species richness, is the count of species in an area. (...) Furthermore, biodiversity encompasses the genetic variety within each species and the variety of ecosystems that species create.”

- Encyclopedia Britannica⁵

“IF THE BEE DISAPPEARED OFF THE SURFACE OF THE GLOBE THEN MAN WOULD ONLY HAVE FOUR YEARS OF LIFE LEFT. NO MORE BEES, NO MORE POLLINATION, NO MORE PLANTS, NO MORE ANIMALS, NO MORE MAN.” - ATTRIBUTED TO ALBERT EINSTEIN



The environmental changes can also indirectly influence our wellbeing. An example: more than 75% of our food crops depends on pollination by insects and other animals.⁶ If they disappear, many of our food sources will disappear too. In addition, the collapse of ecosystems in forested or wet areas has adverse effects on the production of oxygen and clean drinking water. This has the consequence that in the long run conflicts will arise because food and clean drinking water have become scarce.⁷



CHALLENGES FOR BIODIVERSITY IN CITIES AND AGRICULTURAL AREAS

Now the question arises, what is the cause of biodiversity loss and how can we counter it? According to a United Nations report, the main causes include the conversion of wilderness into cities and agriculture, pollution, and climate change.⁸ The Netherlands Environmental Assessment Agency adds that other globally significant causes are related to infrastructure, disruption, fragmentation and encroachment by settlements.³

We cannot deny that we, as mankind, are the biggest contributors to biodiversity loss. We as humans are also the only ones who can stop this crisis. Fortunately, our capabilities in this area are growing.



Rotterdam has a goal of creating 20 new hectares of green space by 2022 - photo by Stephan on Unsplash



Singapore aims to be the greenest city in Asia - photo by Anastasia on Unsplash



THE BENEFITS OF BIODIVERSITY IN THE URBAN ENVIRONMENT

In addition to the preservation of plant and animal species, and access to food crops and clean drinking water, there are other benefits to maintaining biodiversity, especially within urban areas:

- **Regulatory functions:** a healthy ecological system within a city has important regulatory functions. Ecologically healthy water keeps itself clean and is healthier. In addition, a strong and varied green structure ensures air purification, fine dust collection, promotion of rainwater runoff, cooling, noise reduction and acts as a windbreak.
- **Social functions:** a green environment has a positive effect on the well-being of residents and makes a city more attractive and liveable.
- **Economic function:** a natural green environment has more value than a paved or 'grey' area, both for citizens and companies. They will often pay more for a property surrounded by greenery.⁹

THIS IS HOW WE CAN COMBAT BIODIVERSITY LOSS IN CITIES

If building new housing results in shrinking and fragmenting habitats, then more biodiversity must be created within this sector. Urbanisation and 'petrification' (paving) go hand in hand, but insects and birds need greenery to live. Urban greening would therefore be a logical step. But how can building designers, property developers, city planners, municipalities and other parties best approach this? In the following way: placing green roofs on both new buildings and renovation projects.

CONSERVE AND PROMOTE LOCAL BIODIVERSITY WITH GREEN ROOFS

Green roofs have a direct positive influence on local biodiversity and can help to increase populations and species diversity. For example, they offer butterflies, bees and hoverflies food and/or good reproduction opportunities that are not available in the vicinity, especially compared to a regular roof.¹⁰ Pollinators also attach great importance to urban green infrastructure for biodiversity. Green roofs are not only important for domesticated honey bees or beekeeping, but also for the preservation of nature and biodiversity as a whole.¹¹ In addition, green roofs are good habitats for birds and can serve as a safe breeding ground.¹²

BIODIVERSITY RESEARCH ON GREEN ROOFS

In 2015 Sempergreen conducted research in collaboration with the Dutch Butterfly Foundation into the amount of biodiversity on its green roofs. A total of 18 different species of insects were observed during the survey on the test tables. 51 species were found on the roof garden of the Sempergreen head office in Odijk, the Netherlands. These included daytime butterflies, moths (including the very rare and endangered varied coronet (*Hadena compta*)), honeybees, bumblebees, wild bees and hoverflies. Besides insects, 4 species of birds were observed, 2 of which were breeding.¹⁰



GREEN ROOFS AS A LINK BETWEEN NATURAL AREAS, CITIES AND THE COUNTRYSIDE

Another advantage of green roofs is, that they can counteract another major cause of biodiversity loss - the fragmentation of natural areas - by forming connecting paths. They form 'stepping stones' that can help birds and insects move within urban areas by connecting parks and gardens with the countryside and/or natural areas. There is a great opportunity here for municipalities and property developers in terms of creating a network of green roofs, and even a chain of new and renovated ecological housing estates within the entire urban area.

Together with other initiatives, such as the application of green façades, green ground covering and the planting of a high variety of indigenous host and nectar plants (and trees), green roofs can create a nature-inclusive city that blends into the natural environment.

EFFICIENT USE OF UNUSED URBAN SPACE

Of course, existing buildings can also be utilised. For example, on average, 46% of the roof surface in the Netherlands consists of flat roofs. All in all, this roof landscape forms more than 600 square kilometres of space that is rarely or never used.¹³ Municipalities can make optimal use of this untapped space by implementing green roofs, resulting in a sustainable living environment for the local flora and fauna.

A SOLUTION FOR EVERY TYPE OF ROOF

A grey roof (without plants) does not contribute to biodiversity and is basically 'wasted space'. If you want your building projects to contribute to increasing biodiversity, there are various types of green roof to choose from. A grey roof, for example, can be made biodiverse by installing a Sedum roof.



Example: eco residential area with green roofs in Almere, the Netherlands

This green roof makes a functional contribution to local biodiversity in the form of nectar plants and can be upgraded with a biodiversity package. If the roof can bear more weight per square metre, you can choose a roof with wild flowers (Wildflower blanket) or with specially selected nectar and host plants (Bees & Butterflies blanket). For green roofs that are specifically intended to attract more birds, nesting boxes, water basins and insect shelters, etcetera, can be added.



LOAD LIMITS AND BIODIVERSITY

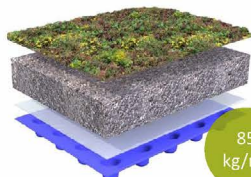
Which green roof you can use on your project depends on the purpose and the load limits of the roof. Biodiverse green roofs have a substrate layer thick enough for insects to pupate. The maximum saturated weight of a biodiverse green roof is therefore 225 kg/m². A traditional Sedum roof has a saturated weight of 85 kg/m², a lightweight green roof 45 kg/m². A biodiversity package has been developed for these roof types that offers both host plants and space for pupation and overwintering. In short, no matter how much weight your roof can support, you can create a fully biodiverse roof on which insects can complete their entire life cycle.



105-225 kg/m²

Biodiverse green roof 0-15°

1. Sempergreen Biodiverse blanket
2. Roof garden substrate biodiverse
3. Drainage including filterfleece



85 kg/m²

Traditional green roof 0-25°

1. Sempergreen Sedum-mix blanket
2. Roof garden substrate extensive
3. Drainage including filterfleece



45-55 kg/m²

Lightweight green roof 0-25°

1. Sempergreen Sedum-mix blanket
2. Substrate roll
3. Drainage including filterfleece



100 kg/m²

Steeply pitched green roof 25-45°

1. Sempergreen Sedum-mix blanket type T
2. Roof garden substrate extensive
3. Substrate holder
4. Water-buffering fleece

GREEN ROOFS COMPARED

The table below shows at a glance how much a green roof type contributes to biodiversity, how much it weighs and how much maintenance is required.

Type of roof	Biodiversity	Maintenance	Weight
Grey roof	-	-	-
Lightweight Sedum roof	🐝 🐝	🌿	⚖️
Traditional Sedum roof	🐝 🐝 🐝	🌿	⚖️ ⚖️
Sedum-herb roof	🐝 🐝 🐝 🐝	🌿 🌿	⚖️ ⚖️ ⚖️
Bees & Butterflies roof	🐝 🐝 🐝 🐝 🐝	🌿 🌿 🌿	⚖️ ⚖️ ⚖️ ⚖️ ⚖️

Read more about the different system structures and possibilities [here](#).



BIODIVERSITY NOT THE ONLY BENEFIT

Green roofs can reduce the loss of urban green space by creating new habitats for plants, insects and birds. But there are more benefits, including countering the effects of climate change and the positive impact on both human wellbeing and the wallet. Climate change is also a major cause of biodiversity loss, so there are also indirect benefits from the application of green roofs.

MORE ADVANTAGES OF A GREEN ROOF

- **Clean air:** green roofs absorb CO₂ and particulates. On average, a Sedum roof stores 1.23 kg of CO₂ per square metre.¹⁴ This means that 813 m² of green roofs absorbs one tonne of CO₂ per year. 1 tonne of CO₂ is equivalent to driving almost 10,000 km in a car running on petrol.¹⁵
- **Water management:** a green roof absorbs rainwater by water buffering in the plants, substrate and drainage. It slows down drainage, purifies rainwater and allows evaporation by the plants. This way, the groundwater level remains stable, peak loads on the sewers are lowered and consequent flooding is reduced.¹⁶
- **Solar panels:** a green roof lowers the temperature on the roof. High heat levels on the roof reduce the output of solar panels.¹⁷ Thanks to the cooler roof, the output of solar panels is higher and it reduces the energy costs of the building.¹⁸ Even with solar panels, the roof covering wears down due to UV radiation and heat stress; a green roof helps to prevent this.

- **Longevity:** a green roof provides protection from the sun, rain, wind and temperature changes, and doubles or triples the lifespan of the roof covering.¹⁶
- **Cooling effect on the environment:** green roofs reflect sunlight, making the interior cooler than a building with a grey roof. This means that air conditioning systems do not have to work as hard in the summer. The use of green roofs can result in a temperature reduction of approximately 3 °C in the city.¹⁶ An good solution to counter the urban heat island effect.
- **Economic benefit:** more and more governments and municipalities provide subsidies for green roofs. In addition, in some countries entrepreneurs and housing corporations can receive fiscal benefits through government schemes by investing in green building solutions.
- **LEED & BREEAM:** building projects with an ecological green roof application are eligible for LEED or BREEAM points.
- **Well-being:** a green environment improves people's physical and emotional state. It also improves concentration.¹⁹ For example, just taking a short break while looking at a green roof for 40 seconds can improve the concentration of employees.²⁰
- **Competitive advantage and regulations:** Rotterdam (The Netherlands), for example, has a green quota,²¹ the city of Melbourne (Australia) recognises "trees and other vegetation as critical urban infrastructure"²² and the city of Hamburg (Germany) has

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provided guidelines for the promotion of green roofs applications in its area.²³ The earlier parties in the construction sector take this into account, the greater the lead on the competition will be.

- **Increase in value:** greening of premises can increase their value by 4 to 8%.¹⁷
- **Simple and quick:** the sooner we start promoting local biodiversity in cities, the greater the chance of avoiding a greater biodiversity catastrophe. Green roofs can be **installed easily**, quickly and on any scale, on both new construction and renovation projects.

CONCLUSION

The world is suffering a biodiversity crisis. If the loss of biodiversity is not halted soon, the consequences for both mankind and planet will be incalculable. One of the greatest causes of biodiversity loss is the disappearance and fragmentation of habitats for plants and animals. This disappearance is largely due to the expansion of urban areas. It is precisely for this reason that the building sector and municipalities are the appropriate parties to make a significant contribution to solving the problem. They can do this by making urban areas greener, building and renovating nature-inclusively. This way, the balance will return and cities will become part of the surrounding nature.

A simple and effective way of urban greening is to make use of little-used city space by applying green roofs. Green roofs are a simple way to make a functional contribution to local biodiversity and can be installed on almost any type of roof. They not only increase natural habitats, but can also form a link between natural areas and thus prevent fragmentation. In addition, green roofs have the ability to absorb CO₂ and particulates, to cool the environment and to buffer water. These are all effective tools in the fight against climate change, which is also a major cause of the biodiversity crisis. Green roofs also offer economic benefits and biodiversity is increasingly higher on the wish lists of provinces and municipalities. All these advantages make it both useful and attractive to invest in green roofs.

In any case, it's important to start greening urban areas as soon as possible. Fortunately, green roofs can be applied easily, in no time and on any scale, to both new construction and renovation projects. So there is no excuse not to start improving biodiversity immediately and make the world a little greener and more liveable every day.



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