Bumblebee Salvation

—Create a pollinator-friendly garden in Villa Arconati

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Abstract

The Arconati garden is a pollinator-friendly garden that has established a vibrant culture of participatory crop production that has transformed and revitalized Arconati's farms. In the face of the climate crisis, land desertification, COVID-19, and other crises, Arconati Farm envisions a new farm model for bumblebee conservation in which eco-friendliness, site vitality, agricultural knowledge transfer, social equity, and energy cycles are demonstrated. The design integrates production, research, and recreation activities into the landscape to restore the natural environment, promote knowledge production, revitalize the regional urban economy, and alleviate social anxiety, constituting a dynamic balance at the ecological, environmental and human activity levels. At the same time, the design establishes a friendly and mutually beneficial relationship between humans and the environment, drives a concentration of public consciousness, and provides architecture for the city with a spontaneous cycle of power sources.

Key words

pollinator-friendly; garden; bumblebee; dynamic balance ; interdependent

Astratto

L'orto di Arconati è un orto amico degli impollinatori che ha instaurato una vibrante cultura di produzione agricola partecipativa che ha trasformato e rivitalizzato le fattorie di Arconati. Di fronte alla crisi climatica, alla desertificazione dei terreni, al COVID-19 e ad altre crisi, la Fattoria Arconati immagina un nuovo modello di fattoria per la conservazione dei bombi in cui si dimostrano l'ecocompatibilità, la vitalità del sito, il trasferimento delle conoscenze agricole, l'equità sociale e i cicli energetici. Il progetto integra le attività di produzione, ricerca e ricreazione nel paesaggio per ripristinare l'ambiente naturale, promuovere la produzione di conoscenza, rivitalizzare l'economia urbana regionale e alleviare l'ansia sociale, costituendo un equilibrio dinamico a livello ecologico, ambientale e di attività umana. Allo stesso tempo, il progetto stabilisce un rapporto amichevole e reciprocamente vantaggioso tra l'uomo e l'ambiente, guida una concentrazione di coscienza pubblica e fornisce un'architettura per la città con un ciclo spontaneo di fonti di energia.

Parole chiave

rispettoso degli impollinatori; giardino; bombo; equilibrio dinamico; interdipendente

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1. BACKGROUND

1.1 BUMBLEBEE ARE IN TROUBLE

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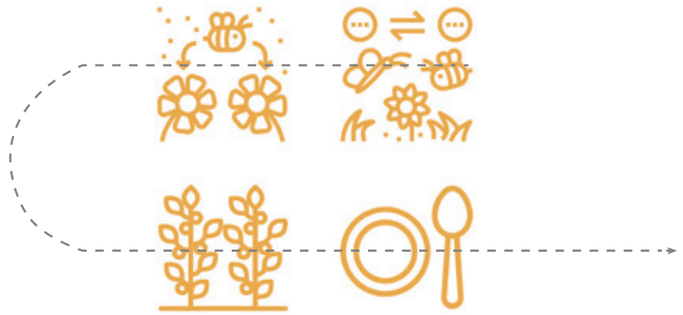
1.1 BUMBLEBEE ARE IN TROUBLE

WHAT IS THE PROBLEM?

Bumblebees are important pollinators, providing important ecosystem services and safeguarding biodiversity through pollination services. Bumblebees are not only key pollinators of wild plants, but also indirectly contribute to the diversity of predators and parasitic wasps. They are also of great commercial value, and their pollination helps agricultural production.The bumblebee's robust body size, long tongue, and colony pollination behavior (the high-frequency buzzing that releases pollen from flowers) significantly improves pollen transfer efficiency in crops such as tomatoes and berries.[12]

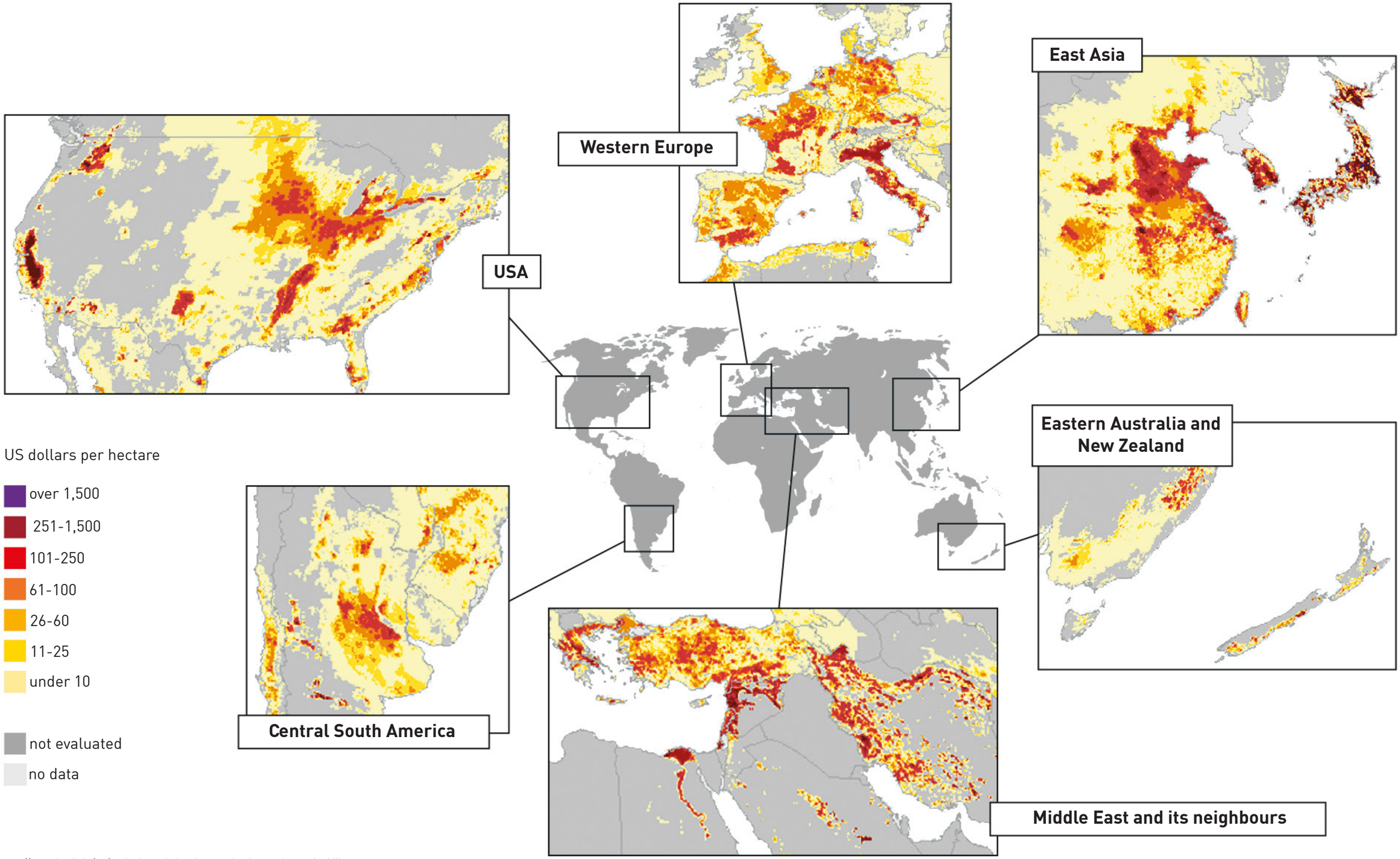
1.https://www.washingtonpost.com/wp-srv/special/metro/urban-jungle/pages/110712.html
2.Michelle L. Boone, Elaine Evans, Amy Wolf, Halley Minser, Jay Watson, Tamara A. Smith, Notes from rusty patched bumble bee (Bombus affinis Cresson) nest observations , Insect Conservation and Diversity, 15, 3, (380-384), (2022).



The decline of pollinators has gradually become a serious problem facing the world, and at the same time, its significance for global food production, stability of pollination services, and plant-pollinator networks cannot be ignored.[1]

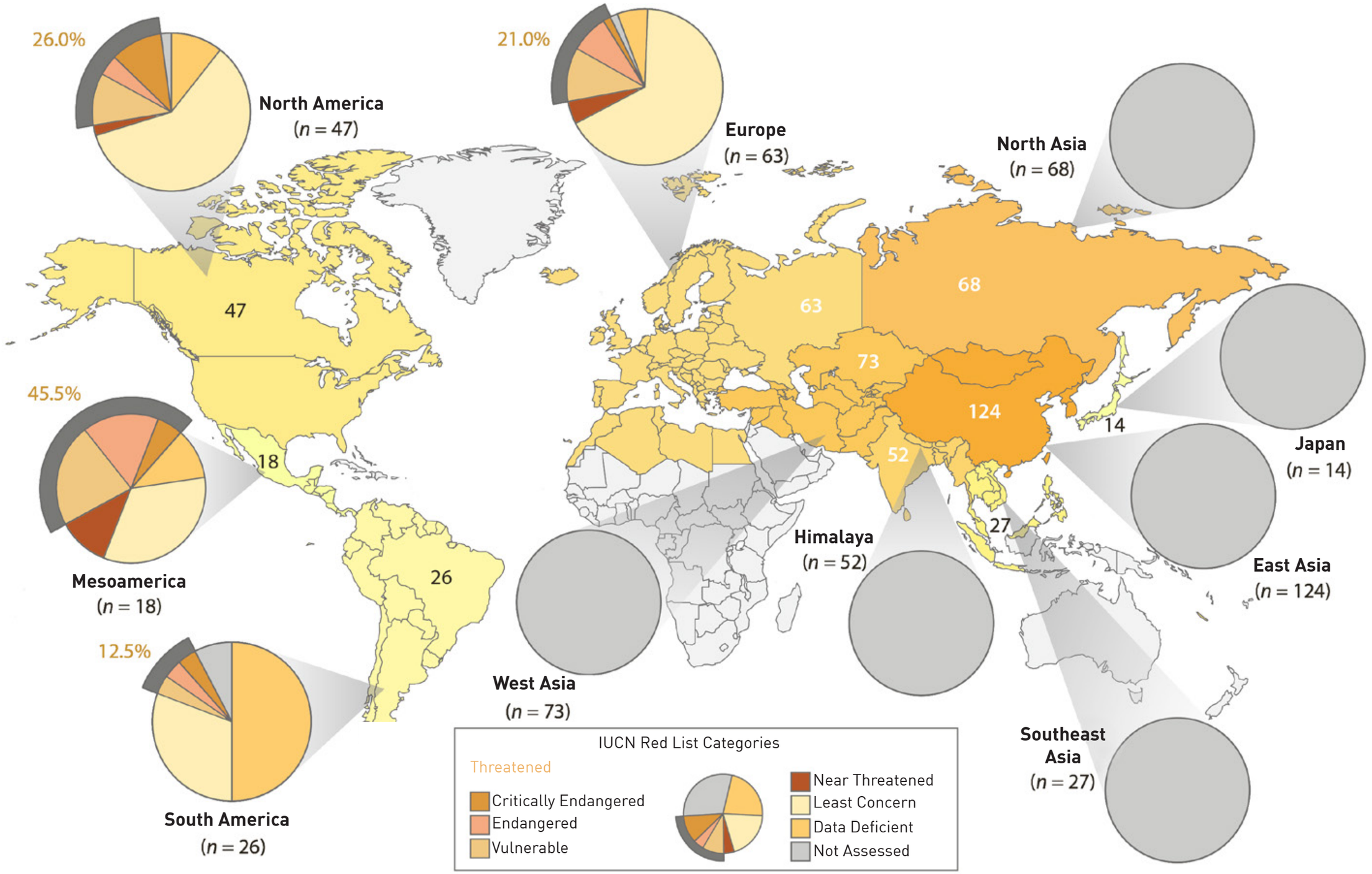
1.Michelle L. Boone, Elaine Evans, Amy Wolf, Halley Minser, Jay Watson, Tamara A. Smith, Notes from rusty patched bumble bee (Bombus affinis Cresson) nest observations , Insect Conservation and Diversity, 15, 3, (380-384), (2022).

THE VALUE THAT POLLINATORS PROVIDE TO AGRICULTURE



https://www.boell.de/en/agriculture-balancing-production-and-sustainability

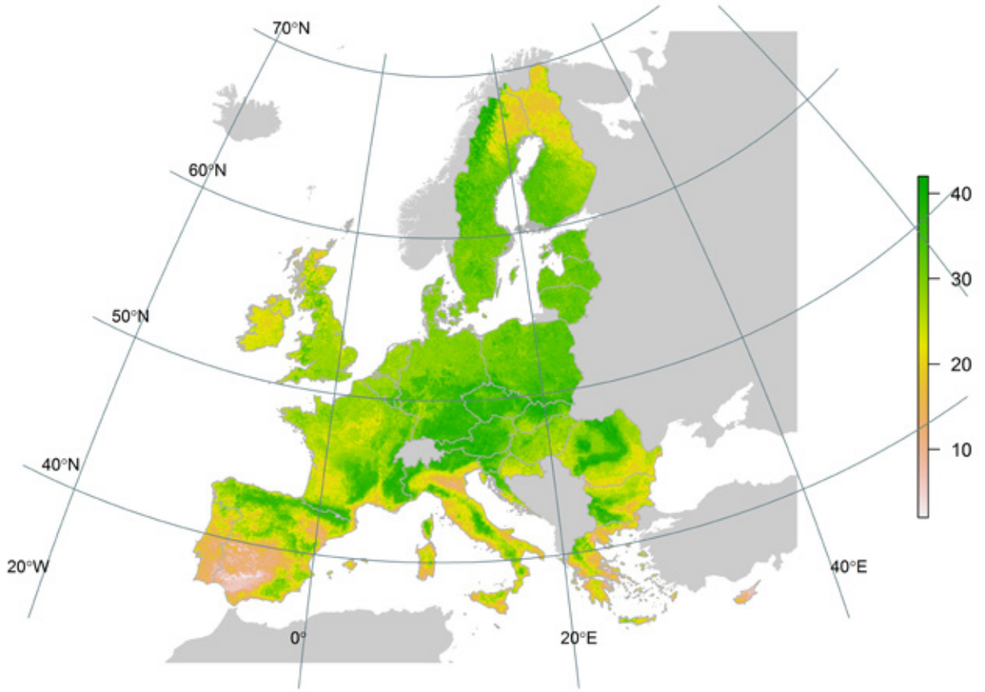
THE WORLDWIDE DISAPPEARANCE OF THE BUMBLEBEE



Cameron, Sydney Anne and Ben M. Sadd. "Global Trends in Bumble Bee Health." Annual review of entomology (2019): n. pag.

BUMBLEBEE SPECIES RICHNESS IN EUROPE

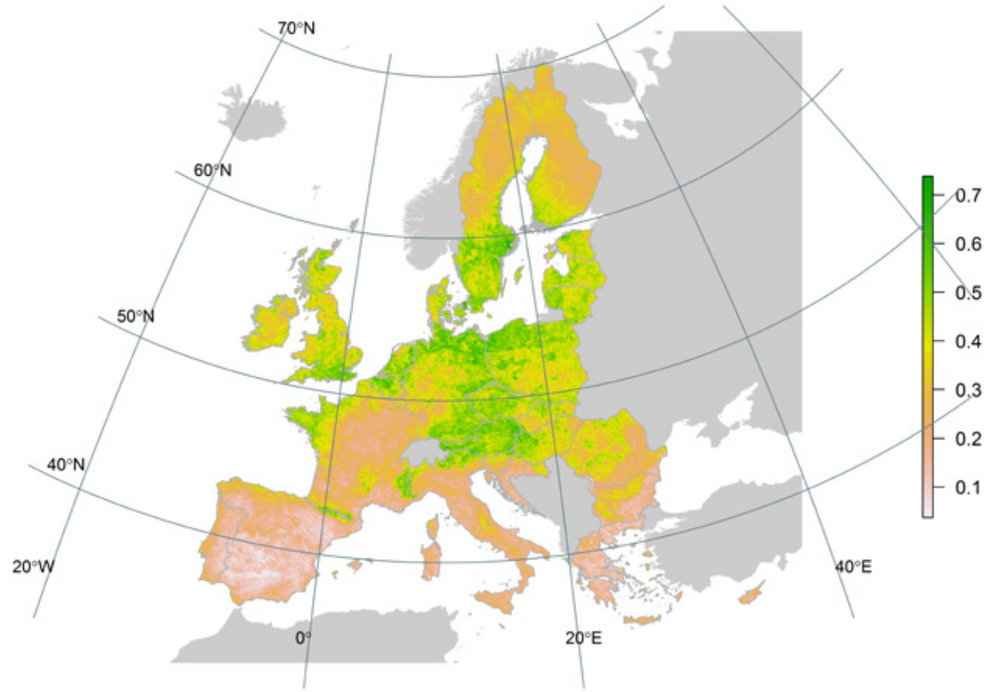
Bumblebee species richness



In 2018, Chiara Polce et al. predicted the potential richness of bumblebee species in order to better detect and protect them. It predicted the species population of bumblebees in the European range using the sum of the species population maps of 47 European bumblebee species. The presence of each species was defined as the probability of occurrence using a single threshold applied to the prediction, and the final map expressed the potential number of bumblebee species in the area, known as potential species richness.[1]

1.Polce C, Maes J, Rotllan-Puig X, Michez D, Castro L, Cederberg B, Dvorak L, Fitzpatrick Ú, Francis F, Neumayer J, Manino A, Paukkunen J, Pawlikowski T, Roberts S, Straka J, Rasmont P (2018) Distribution of bumblebees across Europe. One Ecosystem 3: e28143.

Bumblebee probability of occurrence

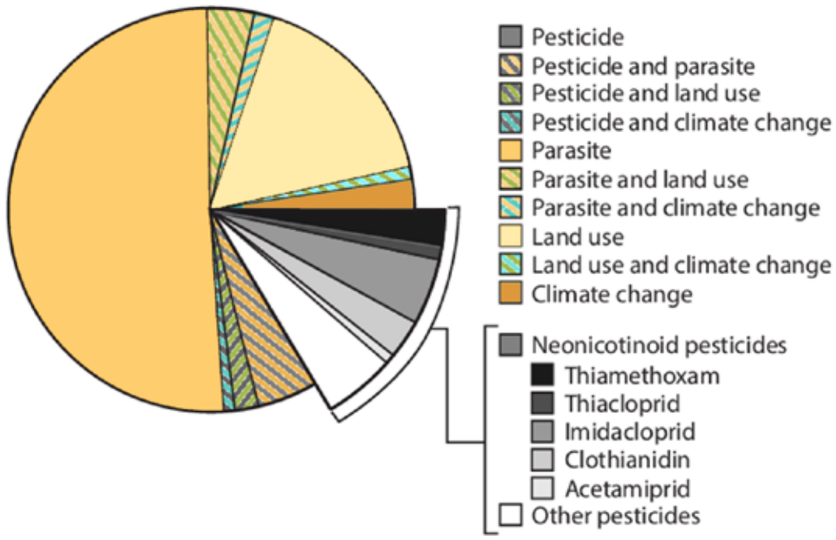


Superimposed the distribution maps of different bumblebee species and divided by the species richness map, the average is the predicted probability of bumblebee occurrence.[1]

1.Polce C, Maes J, Rotllan-Puig X, Michez D, Castro L, Cederberg B, Dvorak L, Fitzpatrick Ú, Francis F, Neumayer J, Manino A, Paukkunen J, Pawlikowski T, Roberts S, Straka J, Rasmont P (2018) Distribution of bumblebees across Europe. One Ecosystem 3: e28143.

CAUSE

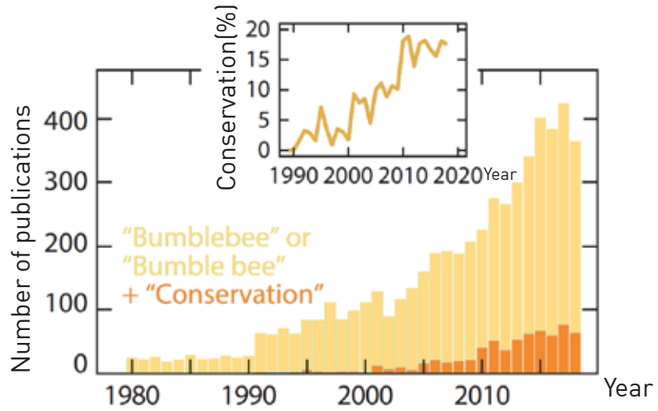
Proposed causes of bumblebee decline in peer-reviewed literature



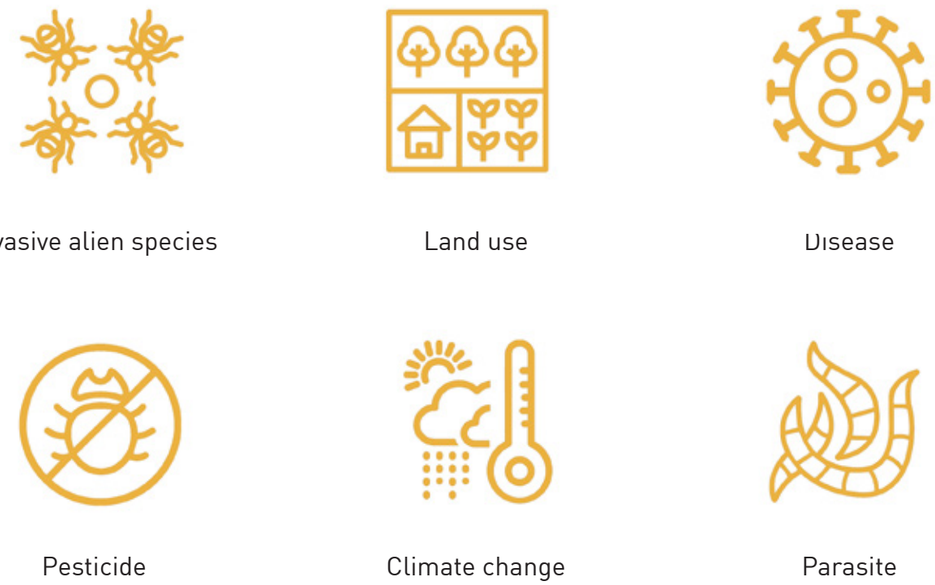
It can be seen from the statistics of the number of documents in recent years that the number of articles on bumblebee research and protection has increased exponentially.
Categorizing them by reasons for the decline of bumblebees, the graph shows that the categories of pesticides, parasites, land use, and climate change are the most numerous, and that within the pesticides category, the studies on neonicotinoid pesticides are the most numerous.[1]

1.Cameron, Sydney Anne and Ben M. Sadd. "Global Trends in Bumble Bee Health." Annual review of entomology (2019): n. pag.

Proposed causes of bumblebee decline in peer-reviewed literature

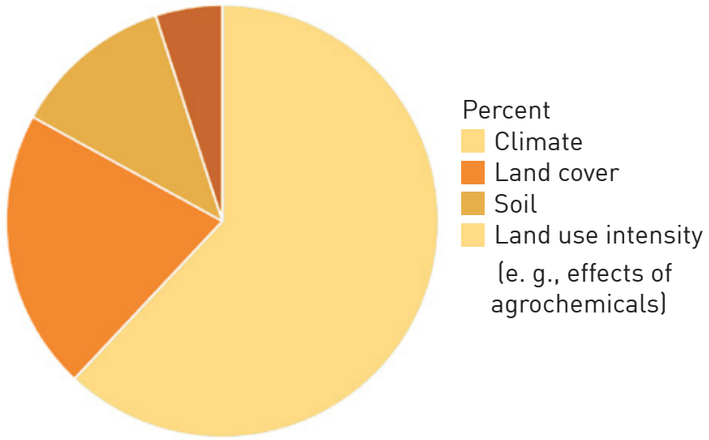


Causal factors of bumblebee decline



CHANGE IN BUMBLEBEES SPECIES RICHNESS

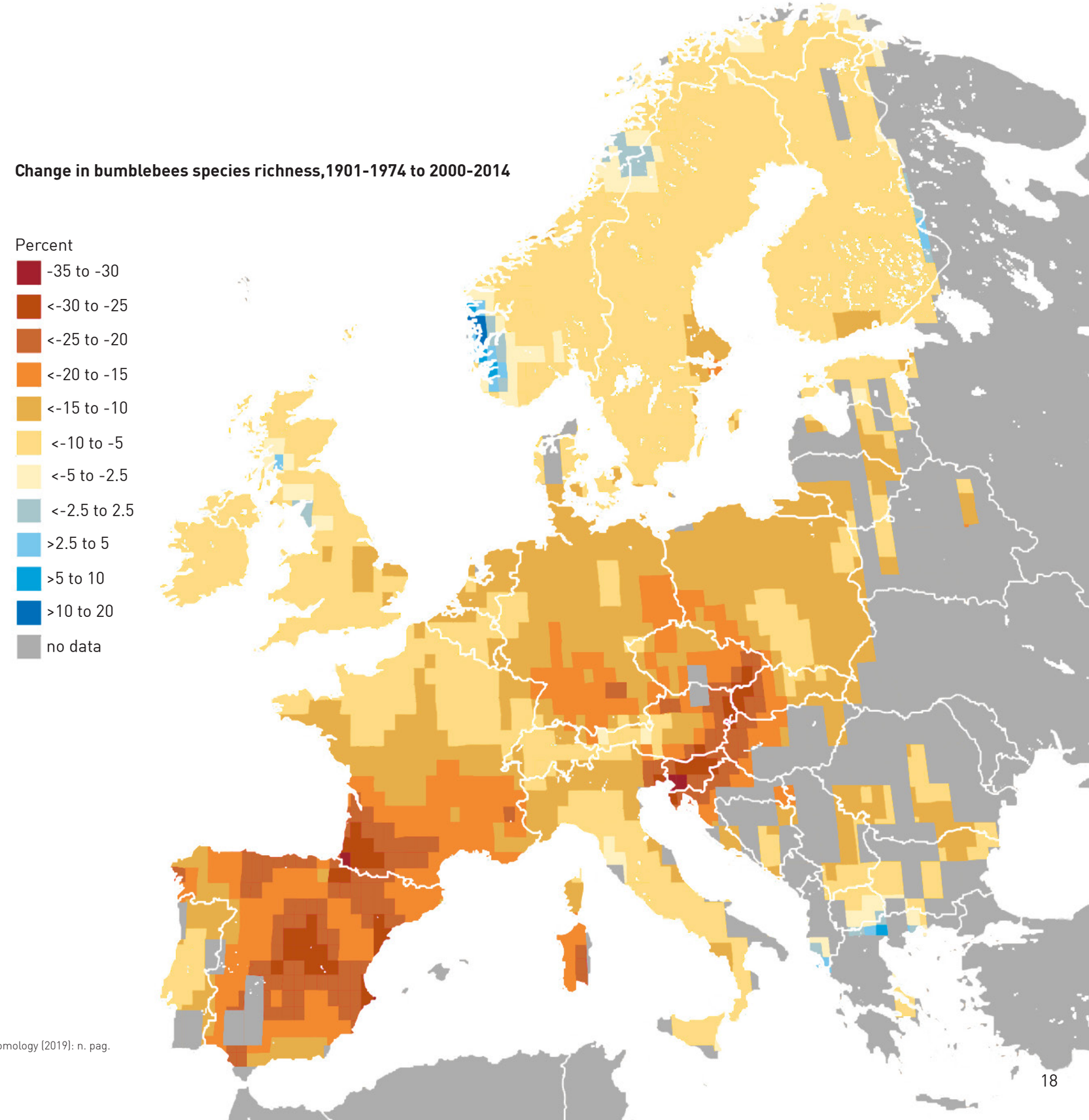
Main influencing factors



Habitat loss and fragmentation due to land-use changea, emerging parasites and disease, urban warming, invasive alien species, and pesticides pollution reduce ecosystem services, which are factors of the declination of pollinators. Among them, the loss of habitat suitable for bumblebee activity is the main reason for the decline of bumblebee.
Therefore, it is an effective way to alleviate the disappearance of bumblebee from the problems of habitat fragmentation, loss of flower and nesting resources, disease and climate warming.[1]

1.Cameron, Sydney Anne and Ben M. Sadd. "Global Trends in Bumble Bee Health." Annual review of entomology (2019): n. pag.

Change in bumblebees species richness,1901-1974 to 2000-2014



IMPACT

Main influencing factors

Crops

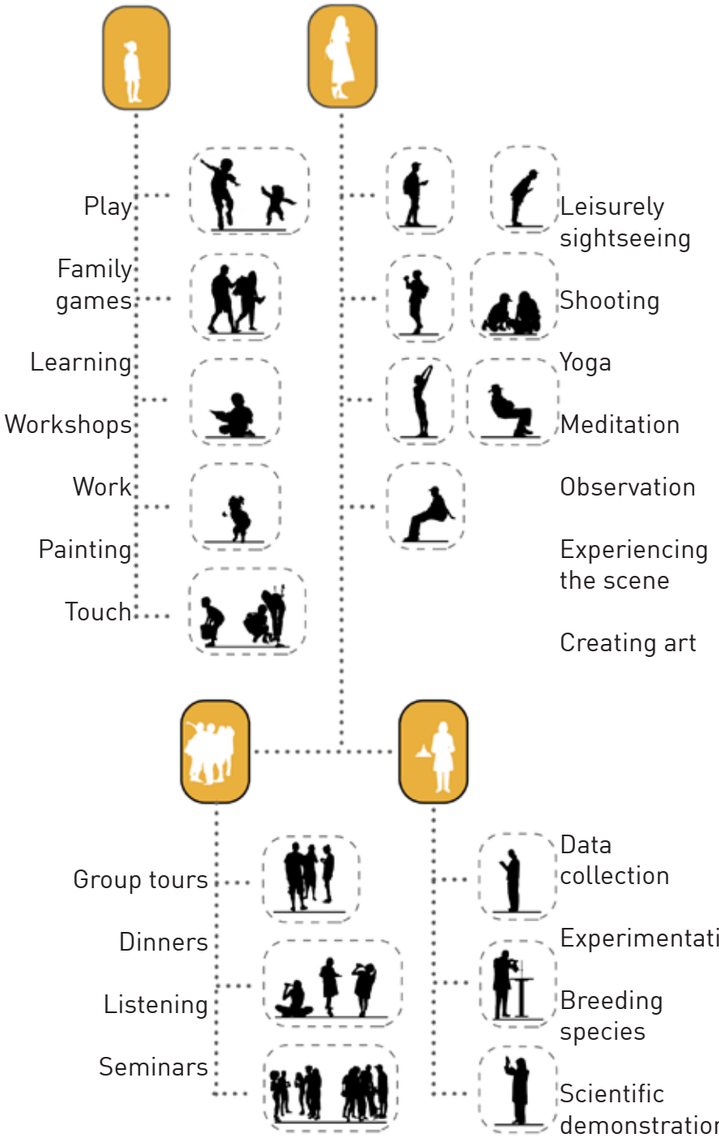
Economic benefits

Biodiversity

Ecosystem stability

The loss of bumblebees would cause irreparable damage to crop yields, economic benefits, biodiversity, and ecosystem stability.Because bumblebees are essential pollinators, and their decline may have widespread ecological consequences.They are important pollinators of wild flowering plants and crops. Their ability to fly at cooler temperatures and lower light levels than many other bees makes them excellent pollinators - especially at higher elevations and higher latitudes. Many plants, including many wildflowers and crops such as tomatoes, blueberries, peppers and cranberries, benefit from bee pollination.[1]

CLOWD ACTIVITY ANALYSIS



1.Mark A. Goddard, Andrew J. Dougill, Tim G. Benton,Scaling up from gardens: biodiversity conservation in urban environments,Trends in Ecology & Evolution,Volume 25, Issue 2,2010,Pages 90-98,ISSN 0169-5347,https://doi.org/10.1016/j.tree.2009.07.016.

1.2 CASE STUDY

Vaux-le-vicomte

The landscape designer: André Le Nôtre
Location: Seine-et-Marne, France
Time:1656-1661

Vaux-le-vicomte is reputed to be the most beautiful French chateau of its era, having been built between 1656 and 1661. The castle's architecture is typically French and its gardens, designed by the famous landscape designer André Le Nôtre, are in the Baroque style. The architecture, as well as the avenues, fountains, sculptures and flower beds in the gardens, are perfectly symmetrical, and the arrangement of the gardens reflects the Baroque style of using nature to imitate nature.[1]

1.Castello di Vaux-le-Vicomte. wikipedia (2021).

The designer has not only used the perspective to enhance the visibility of the garden landscape, but when the viewer stands on the staircase of the building and looks into the distance, the entire garden landscape is presented to them in its entirety. The designers have also used the perspective to hide the large canal that converges in the garden, placing it at the lowest part of the complex, hiding the canal from the main view of the complex and using the natural water resources to build the water features of the garden.[1]

1.Westerveld, E. Kasteel van Vaux-le-Vicomte - Maincy (juni 2011). (2011).

Stourhead

Architect:Colen Campbell
Typology: House and garden
Location: Bartain
Time:1741–1780

Stourhead is an 18th century neo-Palladian manor house in England. the lake at Stourhead was created artificially and the walk along its edge was intended as a metaphor for the journey of Aeneas down to the underworld, and passages telling of Aeneas' journey are quoted in the temples surrounding the lake. Meanwhile monuments on the estate are used to frame each other, such as the Pantheon designed by Flitcroft which attracts visitors once they arrive and the view from across the lake beckons.[12]

1.Stourhead. Wikipedia (2022).
2.Lechona. English: Stourhead Garden -Picture of one of the most beautiful gardens in Southern England. (2004).

Hestercombe's landscape garden

Architect:Gertrude Jekyll
Typology: Garden
Location: Bartain
Time:1904

Gertrude Jekyll was involved in the design of Hestercombe's landscaped gardens in the 19th century, which were designed with architecture as the main framework, respecting the hardscape character of the display of plants. As one descends the steps of these grey walkways, one finds oneself in a large sunken flower bed with a regular geometric border edged in stone and surrounded by lush aspens.5 The straight streams along the garden axis nurture free-growing plants that contrast with the regular geometry and add to the spirit of the garden.[123]

1.https://victorianweb.org/art/parks/hestercombe/1.html.
2.https://www.hestercombe.com/your-visit/gardens.
3.https://en.m.wikipedia.org/wiki/File:Hestercombe_rill3.jpg.

The "ever-changing" garden

Architect:Piet Oudolf
Typology: Garden
Location: Germany
Time:2020

Piet Oudolf uses perennial plant species to create a naturalistic style of gardening, mixing perennials to create a garden that is aesthetically pleasing all year round. Gravel paths are located between various shrubs, ferns, grasses and other herbaceous perennials, offering the viewer a different sensory experience. The garden also incorporates two sculptures, Ring, a circular steel bench under a cherry tree, and Ruisseau, a marble walkway filled with running water.[12]

1.Piet Oudolf creates 'ever-changing' garden for Vitra's architecture park. Dezeen https://www.dezeen.com/2021/07/04/piet-oudolf-garden-vitra-architecture-park-landscape/ (2021).
2.https://www.dezeen.com/2021/07/04/piet-oudolf-garden-vitra-architecture-park-landscape/.

Scampston Hall & Walled Garden

Architect:Piet Oudolf
Typology: Garden
Location: Bartain
Time:1999

The garden features contemporary, perennial meadow planting and the designer has considered the colour and form of the leaves, flowers and stems of the plants at different times of year so that the garden does not just look great at a particular time of year, but that it is aesthetically pleasing in all weathers and seasons. At the same time, Oudolf used serpentine redbud, cubes, ruffled limes and regular hedges for emphasis and contrast, highlighting the orderly yet very distinctive structural character of the landscape.[12]

1.https://www.tripadvisor.it/Attraction_Review-g776616-d3484654-Reviews-Scampston_Walled_Garden-Malton_North_Yorkshire_England.html.
2.Scampston Hall Walled Garden. Candide https://candide.com/GB/places/scampston-hall-walled-garden.

Broughton Grange

Architect:Tom Stuart-Smith
Typology: Garden
Location: Britain
Time:2001

In winter and summer, the geometry of the garden dominates and the viewer can clearly see the neatly manicured landscape, the smooth waterways. But when autumn arrives, the framework of the garden becomes more diffuse, softened by undulating clumps of plants which blur between the edges and blend into each other, bringing a relaxed atmosphere to autumn.[12]

1.https://www.broughtongrange.com/gardens/walled-garden-lower-terrace.
2.https://www.broughtongrange.com/seasons.

kiley-garden

Architect:Harry Wolf and Dan Kiley
Typology: Garden
Location: The United States
Time:completed in 1988

Killy was inspired by the Fibonacci sequence to design the garden's unique grid landscape. He identified the park's main walkways by researching the site's footfall, linking them to the urban grid. Tall sable palms are also arranged along these walkways, with a dense canopy that not only breaks up the regular geometric paving but also provides shade for pedestrians.[12]

1.https://www.nakdesignstrategies.com/ideas/kiley-garden-honoring-the-past-with-timeless-design/.
2.https://www.tclf.org/sites/default/files/microsites/kiley-legacy/KileyGarden.html#!prettyPhoto.

The Palais Royal garden

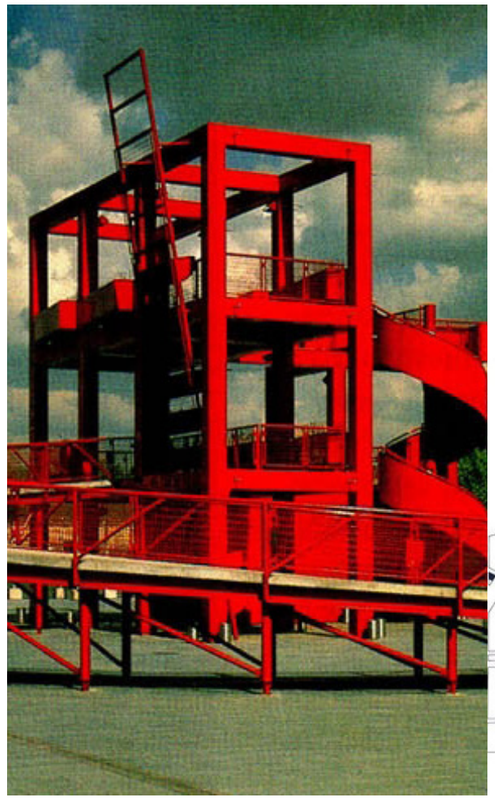
Architect and Time:Le Notre in 1674 and Claude Desgots in 1730
Typology: Garden
Location: France

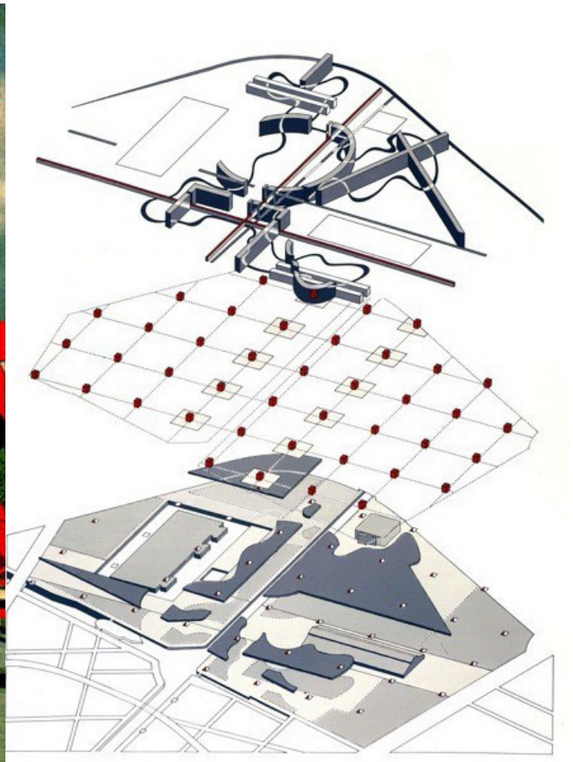
The Palais Royal garden has a long history and is a typical French garden, with a symmetrical emphasis and a prominent axis, with a central fountain separating the two flower beds and bordering the Alley of Colette. It is not only of great political and cultural importance, but also provides a valuable place for the city's citizens to relax.[1]

1.https://www.imageprofessionals.com/en/images/71121007-France-Paris-the-Palais-Royal-garden-redesigned-by-Le-Notre-in-1674-and-his-nephew-Claude-Desgots-in-1730.

Parc de la villette

Architect:Bernard Tschumi
Typology: Park
Location: France
Time:1991





Opposing the popular 19th century notion of a landscape in which the city should not exist in a park, the designer has proposed a design for a social and cultural park that superimposes a new structure on the existing features and conditions of the site, incorporating functional activity areas such as workshops, a gym, bathroom facilities, playgrounds, exhibitions, concerts, scientific experiments, games and competitions, a science and technology museum, and a city of music.[123]

1.http://www.interimeast.org/parc-de-la-villette/
2.https://modulo.net/en/realizzazioni/parc-de-la-villette.
3.https://artevitae.it/wp-content/uploads/2020/10/TSCHUMI-PARC-DE-LA-VILLETTE-PROGETTO.jpg.

Parc André Citroën

Architect:Alain Provost
Typology: Garden
Location: France
Time:1992

The project is an exemplary design for the renovation of the workshop site and the designers have retained the preexisting orthogonality of the site so that it continues into the site's route plan, with all the gardens linked by above-ground walkways, allowing the viewer to experience each garden along a linear sequence. The landscape follows a rigorous geometric design, with hard borders complemented by soft planting, reminiscent of the French gardens of Versailles. The landscape creates a balance between open and private, soft and hard, urban and natural.[12]

1.https://www.villegiardini.it/parc-andre-citroen-a-parigi-natura-e-architettura/ (2022).
2.https://www.kalliergeia.com/en/parc-andre-citroen-the-controversial-beautiful-park/ (2018).

Junya ishigami's art biotop project of a water garden in tochigi

Architects:Junya ishigami
Typology: The botanical farm garden
Location: Tochigi Prefecture, Japan
Proposal time:2018

Japanese architect JUNYA ISHIGAMI designed the ART BIOTOP water garden. The design reuses the water intake gates in the site so that water is pumped into the pond, which is connected to the irrigation system and the water flows continuously at different speeds. The original trees were retained and moss was arranged between the trees and the pond, giving the site a new quality without adding or discarding anything.[1]

1.https://divisare.com/projects/415578-junya-ishigami-associates-art-biotop-water-garden

Junya ishigami's art biotop project of a water garden in tochigi

The trees that were moved and rearranged are trees with deciduous leaves, such as beech, oak and canary, which usually cannot coexist with water, and by waterproofing the pond, this coexistence that never existed before was created. Through the planning of nature, the natural and human environments are more closely integrated and intertwined.[1]

1.https://divisare.com/projects/415578-junya-ishigami-associates-art-biotop-water-garden

SOA: ferme musicale vertical farm

Architects: soa & holdup
Typology: vertical farm, music stage & educational gallery
Location: bordeaux, francefloor
Area: 2,800sqm
Proposal time:2012

The plants attached to the building not only give people in the city more access to nature, but also make the building itself a part of an educational, scientific activity that always invites the observer to learn about food production, every process in the plant's life cycle from sowing to harvesting. With the addition of bio-smart farming methods, the project provides a model for a future where "green" energy production and social needs coexist.[1]

1.https://www.designboom.com/architecture/soa-ferme-darwin-vertical-farm/

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1.https://www.designboom.com/architecture/soa-ferme-darwin-vertical-farm/

Thammasat University – the largest urban rooftop farm in Asia

Architects: Arsom Silp Institute Of The Arts
Typology: Multi-Purpose Building with the Biggest Urban Farming Green Roof in Asia
Location: Bangkok, Thailand
Building Area: 60,000 sq. m
Proposal time:2020

Due to unfettered industrialization and urbanization, Thailand's formerly fertile and productive agricultural land has been converted into industrial land, causing severe pollution to natural ecosystems and exacerbating the problem of extreme weather and flooding. a new integrated solution has emerged at Thammasat University (TU), Thammasat University Green Roofs through modern landscape architecture with traditional Agricultural wisdom, green roofs, urban agriculture, solar roofs, and green public spaces are combined to combat climate change.[1]

1.https://worldlandscapearchitect.com/thammasat-university-the-largest-urban-rooftop-farm-in-asia/

The green roof also provides a system for food production that can be replicated. Urban farms and organic eateries reduce emissions and waste from production, processing, packaging, transportation and disposal by establishing organic food sources and destinations, and leftover food from the table is sent back to the farm as organic fertilizer, making urban spaces more sustainable by reducing the use of chemical pesticides and energy food waste.[1]

1.https://worldlandscapearchitect.com/thammasat-university-the-largest-urban-rooftop-farm-in-asia/

Thammasat University – the largest urban rooftop farm in Asia

It also serves as an educational base for visitors to learn about farming and climate knowledge, to maintain climate justice, and to pass on the land and knowledge to the next generation.
At the same time green roofs promote policy renewal in the agricultural sector by establishing a circular agriculture model that focuses on human well-being and ecological health. It provides employment opportunities for farmers and promotes social income equality through the self-sustainability of rooftop farming.[1]

1.https://worldlandscapearchitect.com/thammasat-university-the-largest-urban-rooftop-farm-in-asia/

Agrotopia

Architects: studio oberhauser
Typology: research facilities for vegetable cultivation with visitor facilities
Location: oostnieuwkerksesteenweg, roeselare, belgium
Total area: 9,500 sqm
Construction dates: 2018-2021

Agrotopia, the largest urban horticulture research center in Europe designed by Dutch architecture firm van Bergen Kolpa Architects and Belgian architecture firm META Architectuurbureau, is a model and exemplar of a more sustainable urban future for food production, intensive space use, recycled energy, and greenhouse horticulture.[1]

1.https://www.designboom.com/architecture/rooftop-greenhouse-agrotopia-urban-horticulture-belgium-02-02-2022/

Agrotopia

Facade of greenhouse on top of silos for rainwater storage

Its innovative water recycling and reuse of urban waste heat, silos for storing rainwater collected from the roof, and waste heat from the nearby mirom waste incinerator to heat the greenhouse, constitute a symbiotic relationship with the urban cycle.[1]

1.https://www.designboom.com/architecture/rooftop-greenhouse-agrotopia-urban-horticulture-belgium-02-02-2022/

Learning workspace

Its construction of greenhouses on existing buildings reconciles the need for greenhouse research facilities with visitor facilities, making Agrotopia a suitable environment for growing plants and a place where people can study and work.[1]

1.https://www.designboom.com/architecture/rooftop-greenhouse-agrotopia-urban-horticulture-belgium-02-02-2022/

Agrotopia

Circular high-tech research facilities

In the building, high-tech research facilities for growing fruits and leafy green vegetables are placed on a route facing the public so that the public can watch the process and scenes of plant cultivation. The building is also divided into four different climate zones where various types of fruits and vegetables can be grown, allowing for efficient use of space and promoting new modes of agriculture.[1]

1.https://www.designboom.com/architecture/rooftop-greenhouse-agrotopia-urban-horticulture-belgium-02-02-2022/

Naval Cemetery Landscape

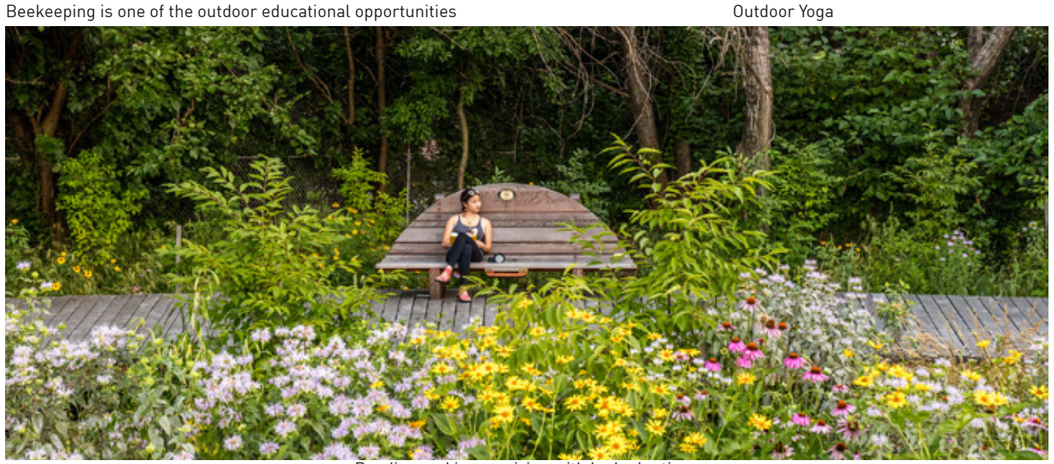
Architects: Nelson Byrd Woltz Landscape Architects
Typology: Cemetery Landscape
Location: Brooklyn, New York, United States
Construction dates: 2010 - 2016

The Naval Cemetery Landscape was planted to provide much-needed native plant nutrition for pollinators such as monarch bees, honeybees and moths, giving an immersive experience of the importance and significance of pollinator habitat in the city.[1]

1.https://www.asla.org/2020awards/485.html

Beekeeping is one of the outdoor educational opportunities

Outdoor Yoga



Reading and immersiving with lush plantings

It also serves as an urban oasis, providing an "open" space for the public to meditate, paint, read, and participate in community activities such as yoga training, art exhibitions, and beekeeping workshops, revitalizing the historic and cultural site and providing a sense of calm and refuge.[1]

1.https://www.asla.org/2020awards/485.html

2. RESEARCH OF KEYSTONE SPECIES

2.1THE APPLICATION OF KEYSTONE SPECIES' RESEARCH IN ECOSYSTEM

2.1 THE APPLICATION OF KEYSTONE SPECIES' RESEARCH IN ECOSYSTEM

BUMBLEBEE AS KEYSTONE SPECIES

The restoration of its dynamic system is an important means to stimulate the reproduction and survival potential of bumblebee. Bumblebee is a key species and its conservation is a concrete and effective means to restore community biodiversity. Based on this, the significance and application of key species were discussed, and the framework of conservation of key species and their habitats on landscape scale was proposed.[1]

1.Goulson, D., Rayner, P., Dawson, B. & Darvill, B. Translating research into action; bumblebee conservation as a case study. J. Appl. Ecol. 48, 3–8 (2011).

The concept of key species has been widely used, and they have qualitative and quantitative effects on their communities. The meaning of key species is

1. The biological process that occurs in the interaction between key species and other species is beneficial to the reproduction of other species, ensuring that biodiversity in ecosystems.
2. The key species maintain the diversity of the ecosystem and are beneficial to the stability of the structure, organization and function of the ecosystem.
3. Relying on the interspecific interaction of key species and related species to improve the utilization rate of ecological resources and enhance the resilience and resilience of landscapes.[1]

1.Easton-Calabria, A., Demary, K. C. & Oner, N. J. Beyond Pollination: Honey Bees (Apis mellifera) as Zootherapy Keystone Species. Front. Ecol. Evol. 6, (2019).

Table 1
Classification of key factors assumed and the impact of removing them from the system

Classification of key factors	Effects of removal
Predator	Leading to an increase in other predators or competitors, and subsequently to the extinction of certain prey or competitors
Prey	Other captured food species may become extinct; The number of predators is likely to decrease
Plant	Extinction of dependent animals
Link	Failure of related plants to reproduce may lead to persistent loss
Modifier	Affecting habitat types and energy flows; Loss of species dependent on specific succession habitats and resources

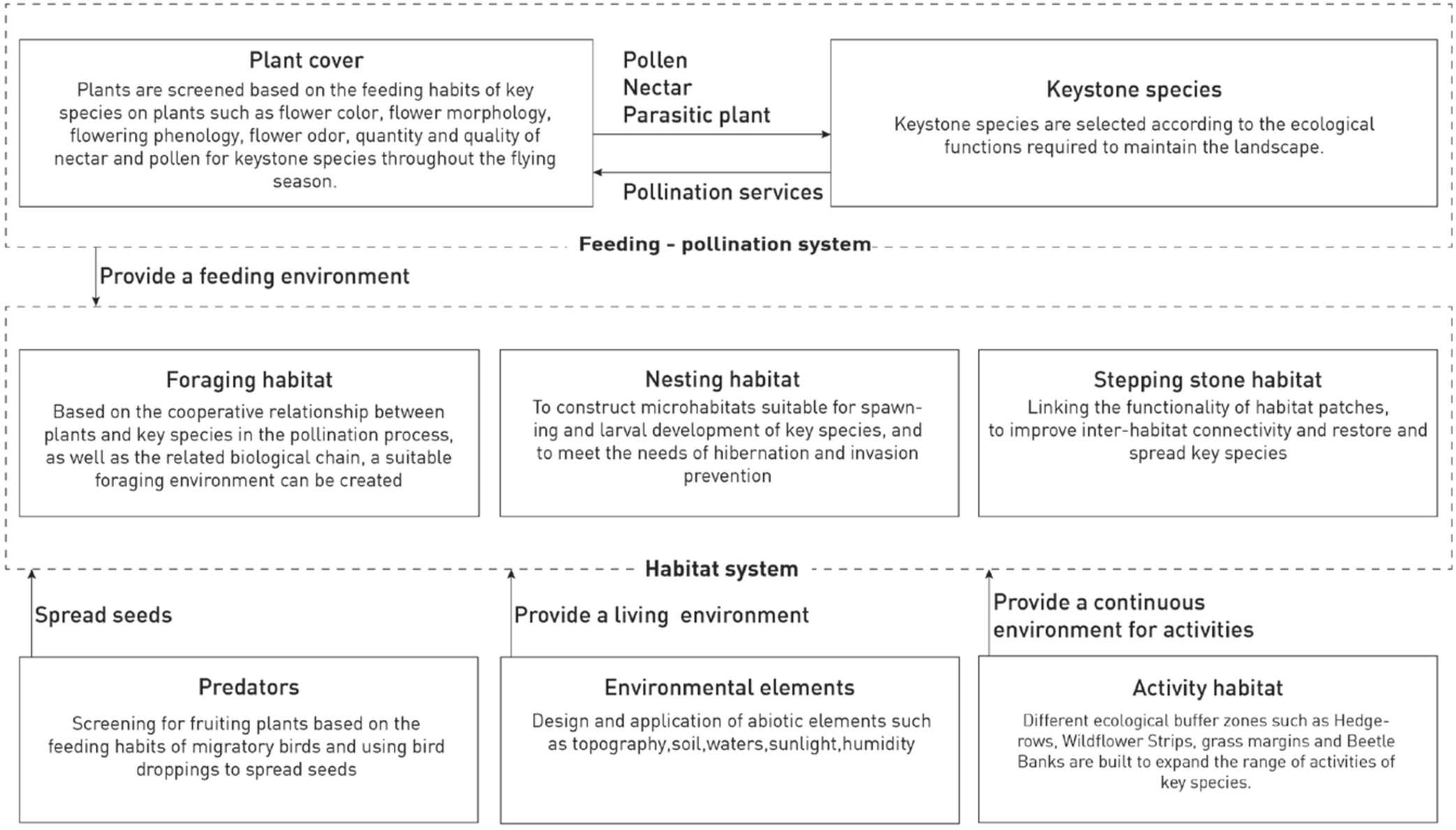
1.Mills, L. Scott, et al. "The Keystone-Species Concept in Ecology and Conservation." BioScience, vol. 43, no. 4, 1993, pp. 219–24, https://doi.org/10.2307/1312122. Accessed 13 Apr. 2022.

Keystone species are those that maintain the structural and functional integrity of an ecosystem. "Keystone species" was first proposed by Robert T. Paine in 1969. Its most important characteristics are that it plays an important role in maintaining the diversity of ecological communities, and second, they have special significance relative to other species in the community. Because of the strong correlation between key species and related species , Keystone species have been promoted as a special means to achieve the goal of maximizing the restoration and maintenance of biodiversity.

This article summarizes the usage of keystone species. (Table 1) This classification does not imply mutual exclusion between the different categories, but rather is for a more comprehensive understanding of keystone species. The key species and the environment are interdependent. The environment provides the key species with the resources and conditions needed for foraging, activity, reproduction, and habitat. The key species also provide important ecological services for the creatures in the environment. The disappearance of the key species will destroy their The stability of the ecological community in which it is located.[1]

1.Beggs, J. R. & Wardle, D. A. Keystone Species: Competition for Honeydew Among Exotic and Indigenous Species. in Biological Invasions in New Zealand (eds. Allen, R. B. & Lee, W. G.) 281–294 (Springer, 2006). doi:10.1007/3-540-30023-6_18.

THE CONSTRACTION OF FRAMEWORK



Conservation of key species requires attention to their living environment and behavior habits, based on the construction of foraging habitat, nesting habitat and stepping stone habitat to create synergistic interactions between pollinators and ecosystem.[1]

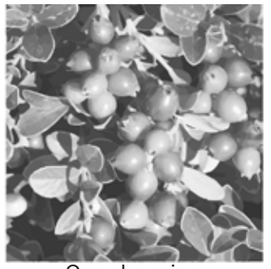
1.Lynch, A. J. Creating Effective Urban Greenways and Stepping-stones: Four Critical Gaps in Habitat Connectivity Planning Research. J. Plan. Lit. 34, 131–155 (2019).

FORAGING HABITAT DESIGN

Bumblebees need pollen nectaries from plants as a food source, and they form a symbiotic structure of "feeding-pollination" with plants. Plants should select nectar-rich native plants to build a landscape group, as the population density of bumblebees is affected by the amount of pollen predated in the previous year, plants should be configured with some late flowering species to provide bumblebees with A continuous source of pollen.

Plant screening


Blueberries

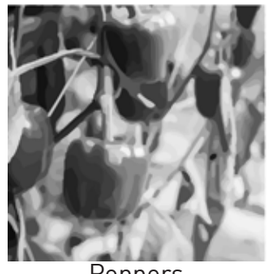

Cranberries


Red clover

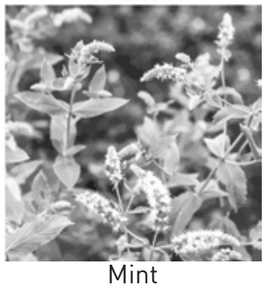

Zucchini


Eggplant


Tomatoes


Peppers


Sunflower


Mint

Bumblebees are important pollinators of high-value crops such as blueberries, cranberries, red clover, zucchini, eggplant, and other crops. They are also the exclusive pollinators of greenhouse tomatoes and peppers, both of which benefit from bee pollination.

Bosch, J., Martín González, A. M., Rodrigo, A. & Navarro, D. Plant–pollinator networks: adding the pollinator's perspective. Ecol. Lett. 12, 409–419 (2009).

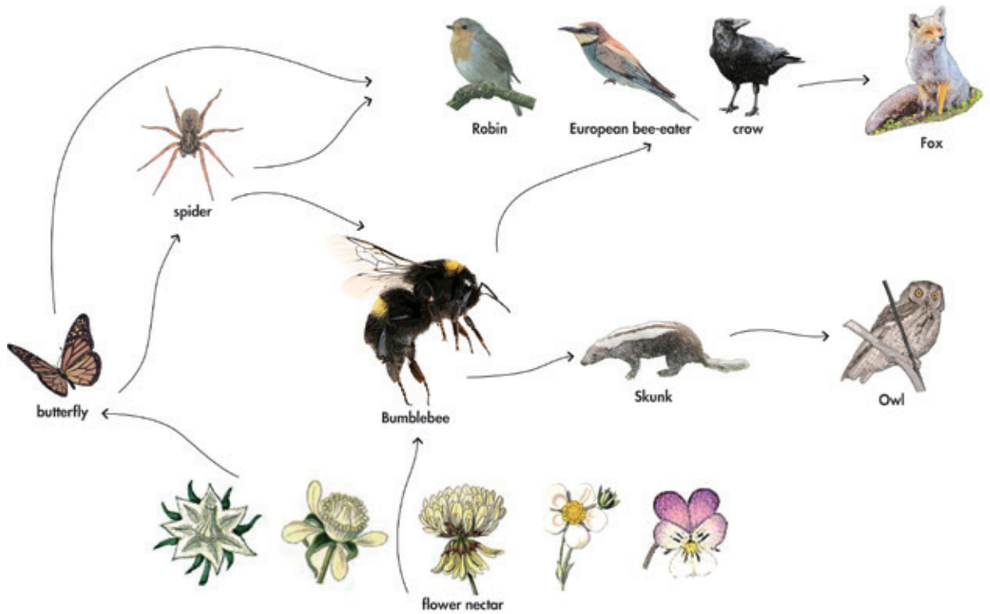
Suzuki, K., Dohzono, I. & Hiei, K. Evolution of pollinator generalization in bumblebee-pollinated plants. Plant Species Biol. 22, 141–159 (2007).

Plant screening

Bumblebees require large amounts of nectar, but the good news is that they are versatile and will collect pollen and nectar from a variety of flowering plants. Post-peak often occurs in early spring and late winter and lasts into late summer or early fall, making bumblebees sensitive to different management practices throughout the year, and thus plant selection is critical; they are an important ingredient in creating valuable habitat that needs to be screened by variables such as bloom time, color and region.
In general, bumblebees prefer purple, blue and yellow flowers; they cannot see red at all. Flowering shrubs and small trees are also excellent early food sources for bumblebees and are often the only plants in bloom in early spring.[1]

1.Cnaani, J., Thomson, J. D. & Papaj, D. R. Flower Choice and Learning in Foraging Bumblebees: Effects of Variation in Nectar Volume and Concentration. Ethology 112, 278–285 (2006).

Food chain of bumblebee



Plant selection takes into account not only the feeding habits of key species, but also the relationships of other predators in the ecosystem in which they live. For example, plant selection should not only consider the preference of bumblebees, but also consider whether the fruit of the plant can provide food for resident and migratory birds. Birds are able to spread undigested seeds to other areas, facilitating the spread of plants.[1]

1.Memmott, J. The structure of a plant-pollinator food web. Ecol. Lett. 2, 276–280 (1999).

NESTING HABITATS DESIGN

Bumblebee nest site selection is influenced by many factors, including genetics, individual experience, and habitat availability. In nature, they nest by searching for abandoned passages of other organisms (e.g., white-footed deer mice, red-backed voles, or chipmunks), and thus bumblebee nests are often scattered and difficult to find, adding to the difficulty of collecting data for research.[1]

1.Osborne, J. L. et al. Quantifying and comparing bumblebee nest densities in gardens and countryside habitats. J. Appl. Ecol. 45, 784–792 (2008).

Artificial bumblebee colony

Different way of domicile installation

(a) (b) (c)

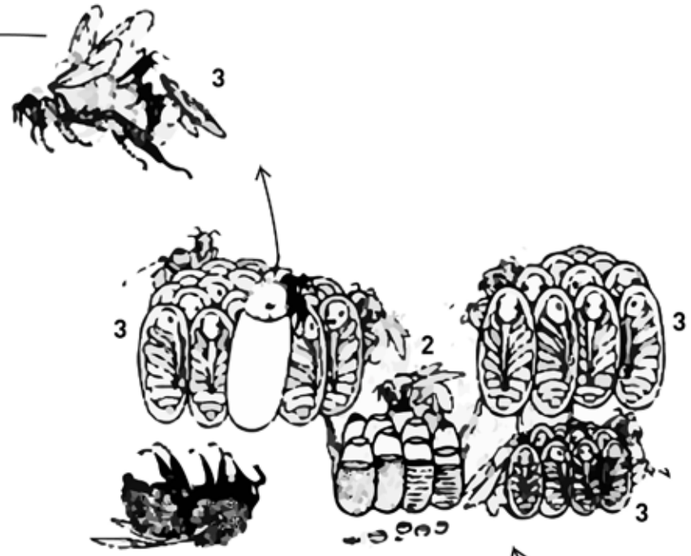
(a) underground before complete burial, (b) aboveground lashed to tree, and (c) false-underground disguised in foliage.

Artificial nests can be a useful tool for collecting information on the nesting behavior of specific species, and in 2019 Meagan et al. placed three different artificial nests for detection, placed above ground, below ground, and pseudo-underground, with the above ground nest installation method having the highest bumblebee occupancy rate, while the pseudo-underground method had no signs of occupied dwellings. The artificial nests not only served as a tool for testing and studying bumblebees, but also provided them with shelter.[1]

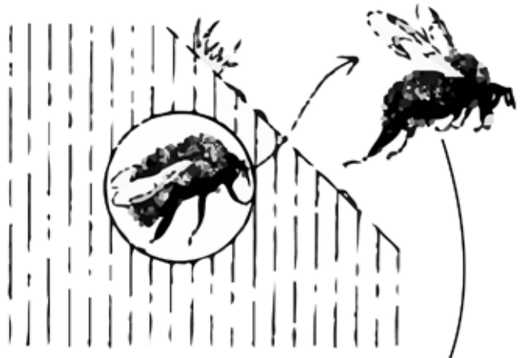
1.Sarah A Johnson, Meagan M Tompkins, Hayley Tompkins, Sheila R Colla, Artificial Domicile Use by Bumble Bees (Bombus; Hymenoptera: Apidae) in Ontario, Canada, Journal of Insect Science, Volume 19, Issue 1, January 2019, 7

In the winter, the queen sleeps in shallow dirt burrows and leaf litter.

The new queen stores the sperm and searches for a winter hibernation spot. Except for the new queens, all members of the colony perish at the conclusion of the season.



Before dying, male bees find new queens from a different colony to mate with.



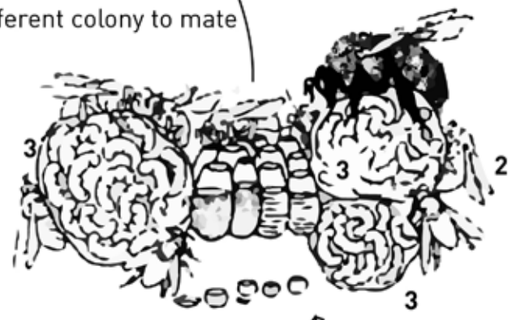
In the spring, the queen emerges from hibernation to feast on early blooming plants like as maple, willow, and bloodroot.

Diagram of a bumblebee colony cycle

Bumblebee is created annually, and only the queen can survive the winter.

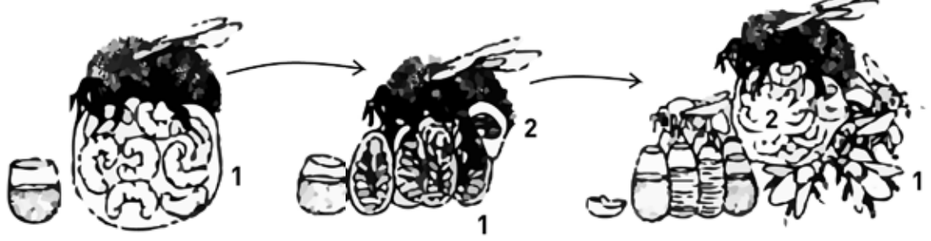
The queen emerging from hibernation to the third brood's new queens emerging from cocoons, mating, and hibernating

Note the development of specific brood packet eggs into larvae, pupae, and adults, as well as the usage of empty cocoons to store honey or pollen.[1]



In an abandoned hole, the queen builds a new nest.

While her initial group of workers develop into adults, the queen lays eggs and forages for nectar and pollen.



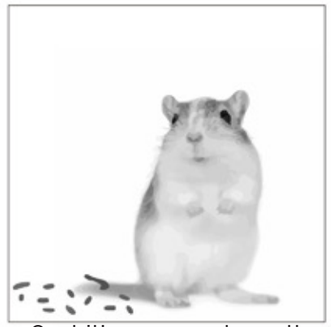
1.Heinrich B. Bumblebee economics[M]. Harvard University Press, 2004.12-15.

The nesting material

Board

Cotton

Scraps of paper



Gerbil's poop and smell

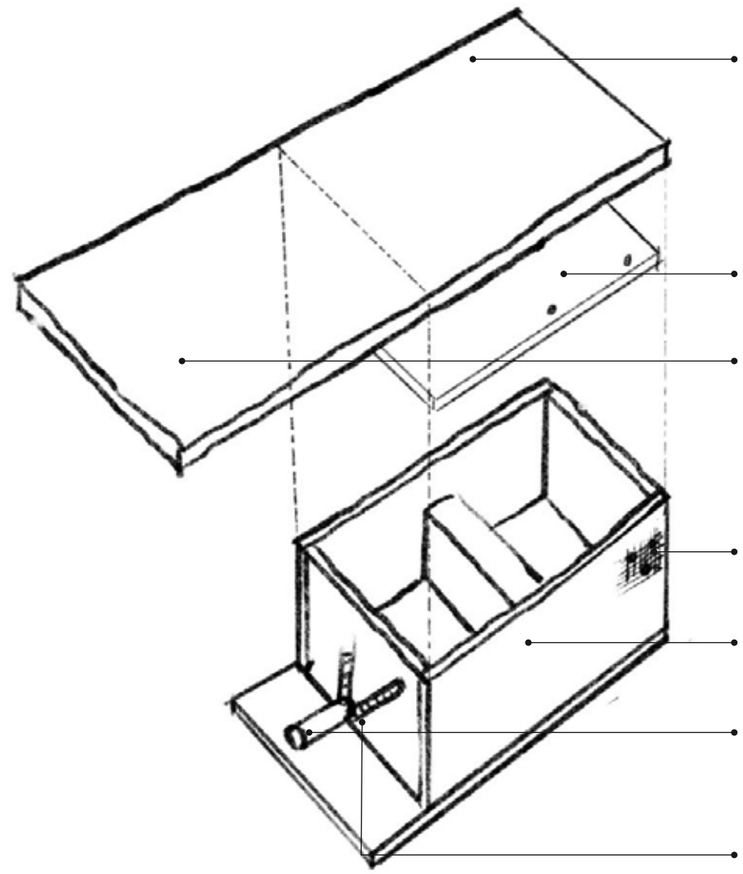
Grain

Sawdust

Gerbil nesting material[1]

1.Lye, G. C., Park, K. J., Holland, J. M. & Goulson, D. Assessing the efficacy of artificial domiciles for bumblebees. J. Nat. Conserv. 19, 154–160 (2011).

Artificial nest



1.https://tomclothier.hort.net/page38.html

STEPPING STONE HABITATS DESIGN

According to the study, bumblebees vary in the distance they forage away from the nest, with estimates ranging from 275 m to 750 m, which is significantly greater than most other native bees. Body size and colony size are good predictors of flight distance between species. Recent evidence also suggests that bumblebee foraging distances decrease when high quality foraging habitats are in close proximity. Thus, adding small patches of vegetated landscape between areas isolated from each other to provide short stops for bumblebee foraging is beneficial for expanding bumblebee foraging range and increasing the stability and sustainability of bumblebee foraging network structure.[12]

1.Knight, M. E, A. P. Martin, S. Bishop, J. L. Osborne,R. J. Hale, R. A. Sanderson, and D. Goulson. 2005.An interspecific comparison of foraging range and nest density of four bumblebee (Bombus) species.Molecular Ecology 14:1811-1820.
2.Osborne, J. L., A. P. Martin, N. L. Carreck, J. L.Swain, M. E. Knight, D. Goulson, R. J. Hale, and R.A. Sanderson. 2008. Bumblebee flight distances in relation to the forage landscape. Journal of Animal Ecology 77:406-415.

3. SITE SURVEY AND DESIGN

3.1 SITE SURVEY

3.2 DESIGN

3.1 SITE SURVEY

SITE SURVEY

The essence of villa arconati's problem is the site decay caused by urbanization which limits people's access to nature and the tremendous opportunity of its is abundant water resources and large area of natural environment on and off Villa Arconati, in which there is lots of wildlife,changeable climate ,complex biological chain, which is very common but is full of possibilities and a special delicate beauty. So the field research is based on the search of links amongst human and ecological resources to create a engine between human and the environment.

SITE SURVEY

The Villa Arconati witnesses the life of the Arconati family, when people staying in this site, they can't help but think of the scenes that someone lived here. The building is the evidence to know how people raise livestocks and store the feedstuff, it is the heritage of the history and culture but in disrepair and unsafe.

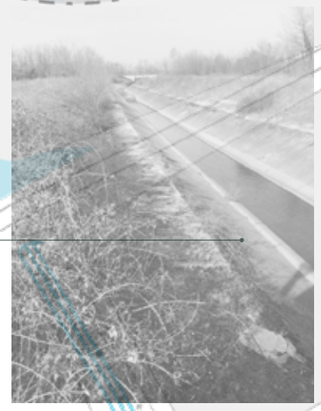
SITE SURVEY

The precipitation in summer is large and changes rapidly. In winter, there is less rainfall and the soil is dry. Ultraviolet radiation is strong when there is sun, and the temperature difference between day and night is large.

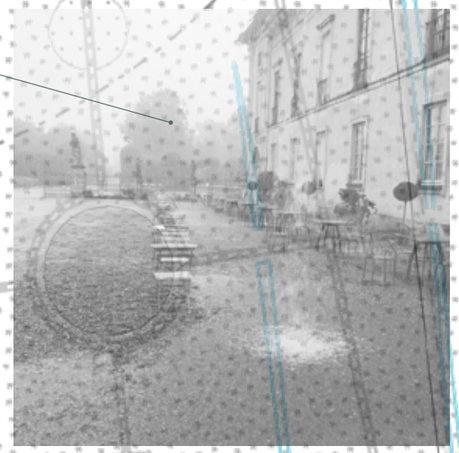
There is a great wealth of water, both underground and surface, they have great potential.. First of all, they have great cultural value, connecting multiple historical and cultural heritages and carrying profound historical and cultural memory. They can let people participate in, feel the nature, and discover, learn and share historical and cultural knowledge. Seconly, Intervention and protection of ecological wetlands and water environments can also contribute to the restoration of biodiversity.

LOCATION OF THE SITE AND DISTRIBUTION OF WATER RESOURCES

Villa Arconati is a country palace and garden located in the Castelazzo district of the town of Bolat, northwest of Milan, Italy. Built in the 17th and 18th centuries, it bears witness to the life of the Arconati family and carries the memory of the people who lived here, raising livestock, and is a historical and cultural heritage. The villa is now used as a museum and as a venue for events and conferences, but its farm is in a state of disrepair.



Both underground and on the surface are very rich in water, and they have great potential. First of all, they have great cultural value, connecting multiple historical and cultural heritages and carrying deep historical and cultural memories. They allow people to participate, to experience nature, to discover, learn and share historical and cultural knowledge. Secondly, intervention and protection of ecological wetlands and water environments can also contribute to the recovery of biodiversity.



Site climate: In summer, precipitation is high and changes quickly. In winter, there is less precipitation and dry soil. Strong ultraviolet radiation when there is sun and large temperature difference between day and night.

Via d'Acqua Nord

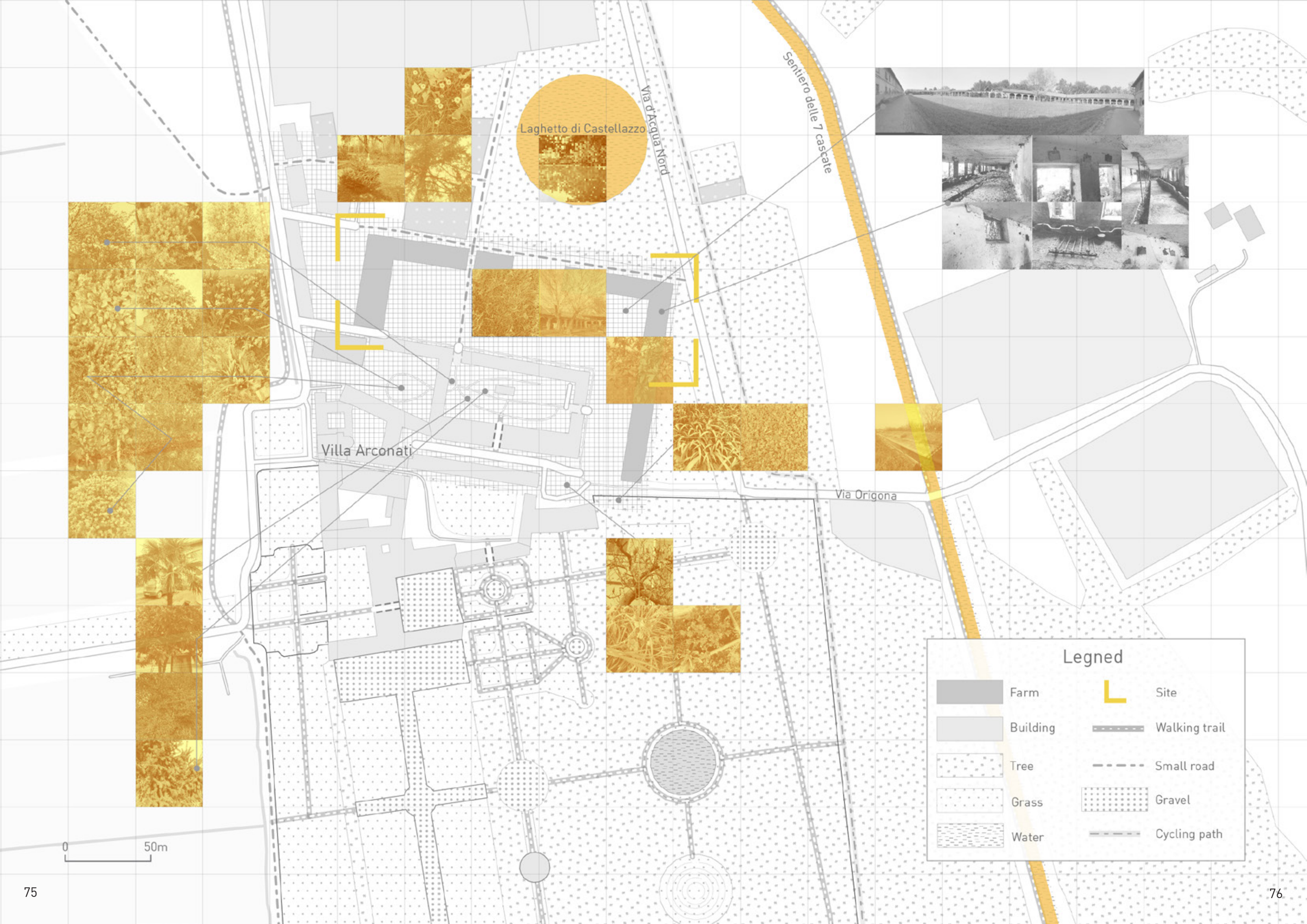
Villa Arconati

Via Origona

0 50m

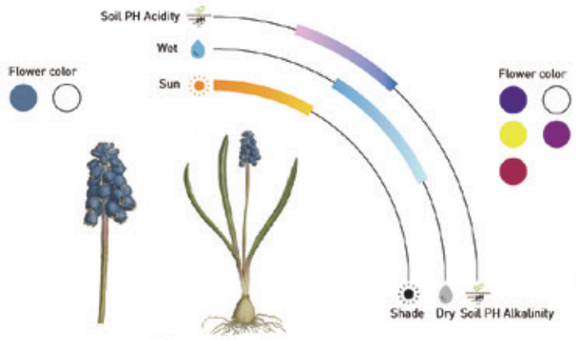
Legend

- Pond
- Building
- Tree
- Grass
- Water
- Seasonal river
- Walkway
- Small road
- Pebbles
- Bike path

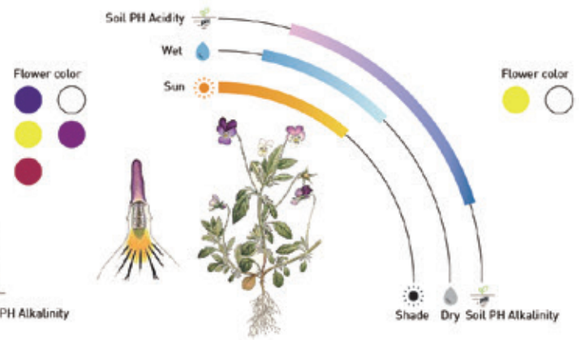

Laghetto di Castellazzo
Via d'Acqua Nord
Sentiero delle 7 cascate
Villa Arconati
Via Origona
0
50m
Legned
Farm
Building
Tree
Grass
Water
Site
Walking trail
Small road
Gravel
Cycling path

PLANTS IN SITE

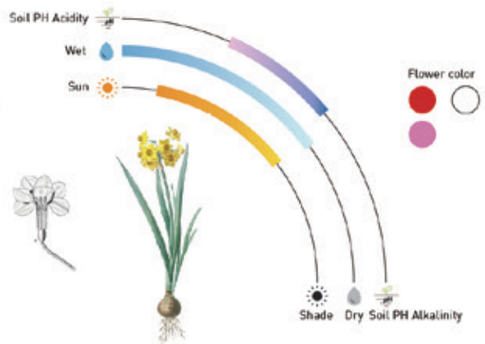
Collect the abundant plants with local characteristics around the site and analyze the living habits of these plants.



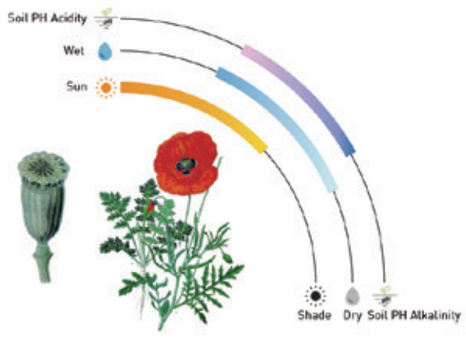
Muscari botryoides



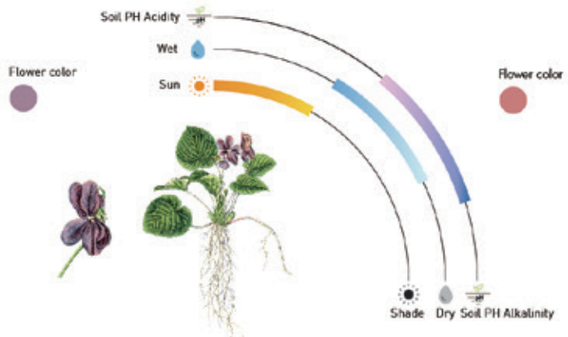
Viola tricolor L.



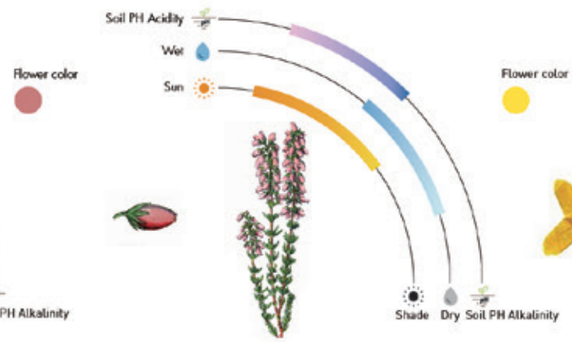
Narcissus tazetta



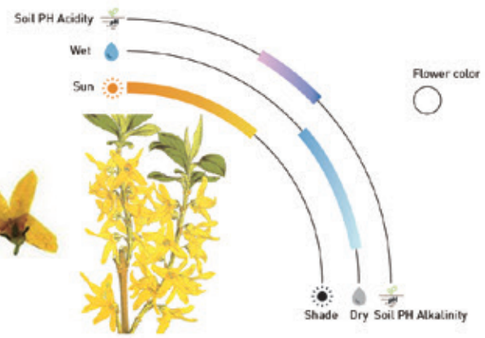
Papaver rhoeas L.



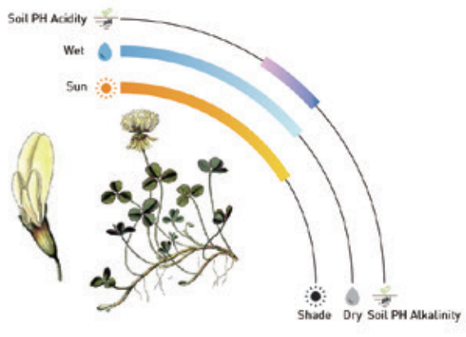
Viola philippica



Erica L.



Forsythia viridissima Lindl.



Clover

IMPORTANCE OF BUMBLEBEE FOR CROPS

In this framework, crops are necessary, on the one hand, bumblebees need their pollen and nectar for reproduction, foraging, nesting, hibernation and other activities, on the other hand, crops provide value to human beings, offering the possibility of research, education, farming, conservation, harvesting, eating and many other activities, and are the source of the economic drive of the site.

Vicia faba L.

Lycopersicon esculentum Miller

Fragaria

Viola tricolor L.

Brassica napus L.

Malus pumila Mill.

https://en.wikipedia.org/

Capsicum frutescens L.

Cyanococcus

Fagopyrum esculentum Moench.

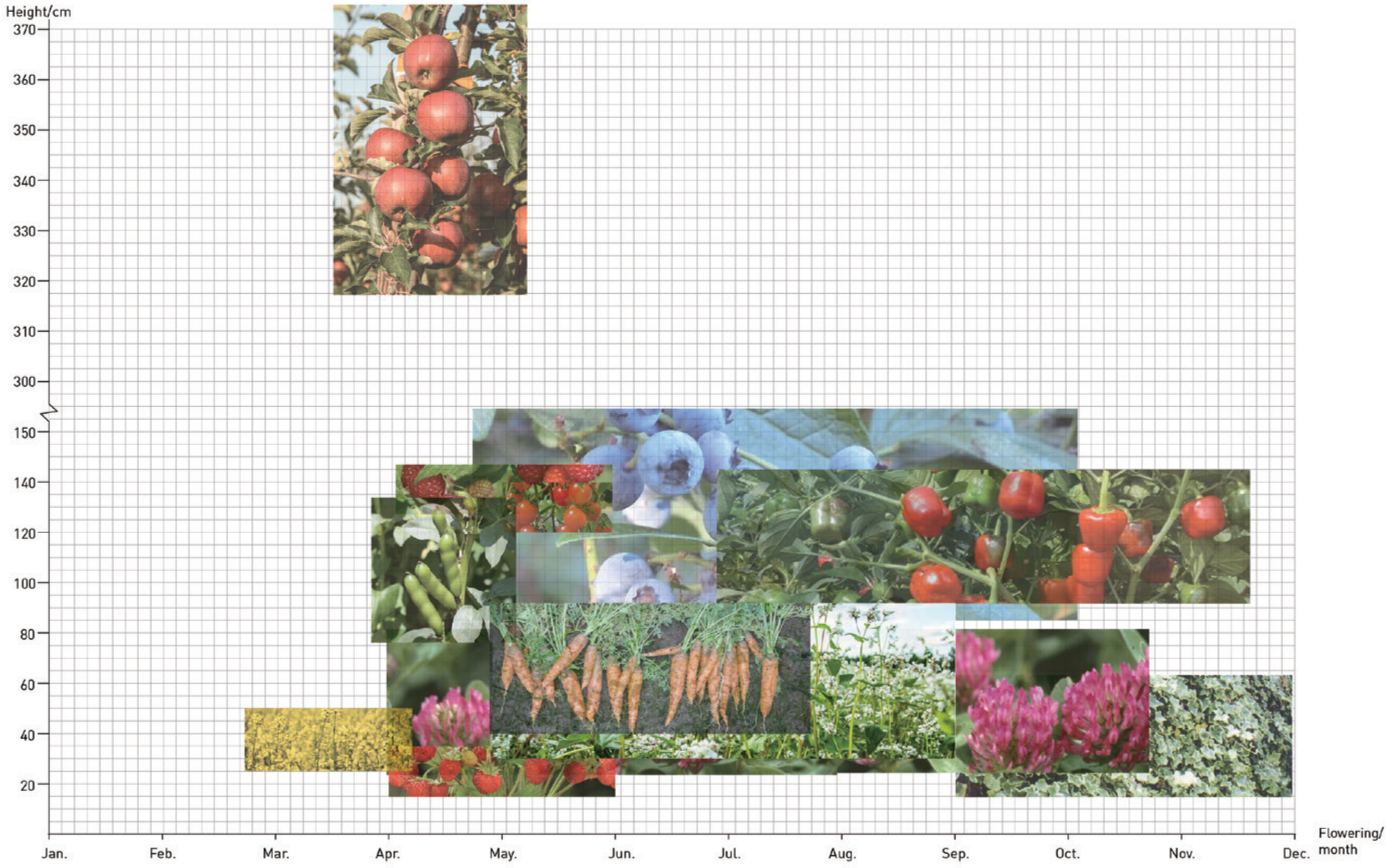
Trifolium pratense L.

Daucus carota subsp. sativus

Hedera helix

https://en.wikipedia.org/

FLOWEING TIME AND PLANT HEIGHT OF THE CROP



FLOWERS BENEFIT TO BUMBLEBEE

In this framework, cr

Dwarf Blue Cornflower

Large-Leaved Lupine

Betonica officinalis

Borago officinalis

Buddleja davidii

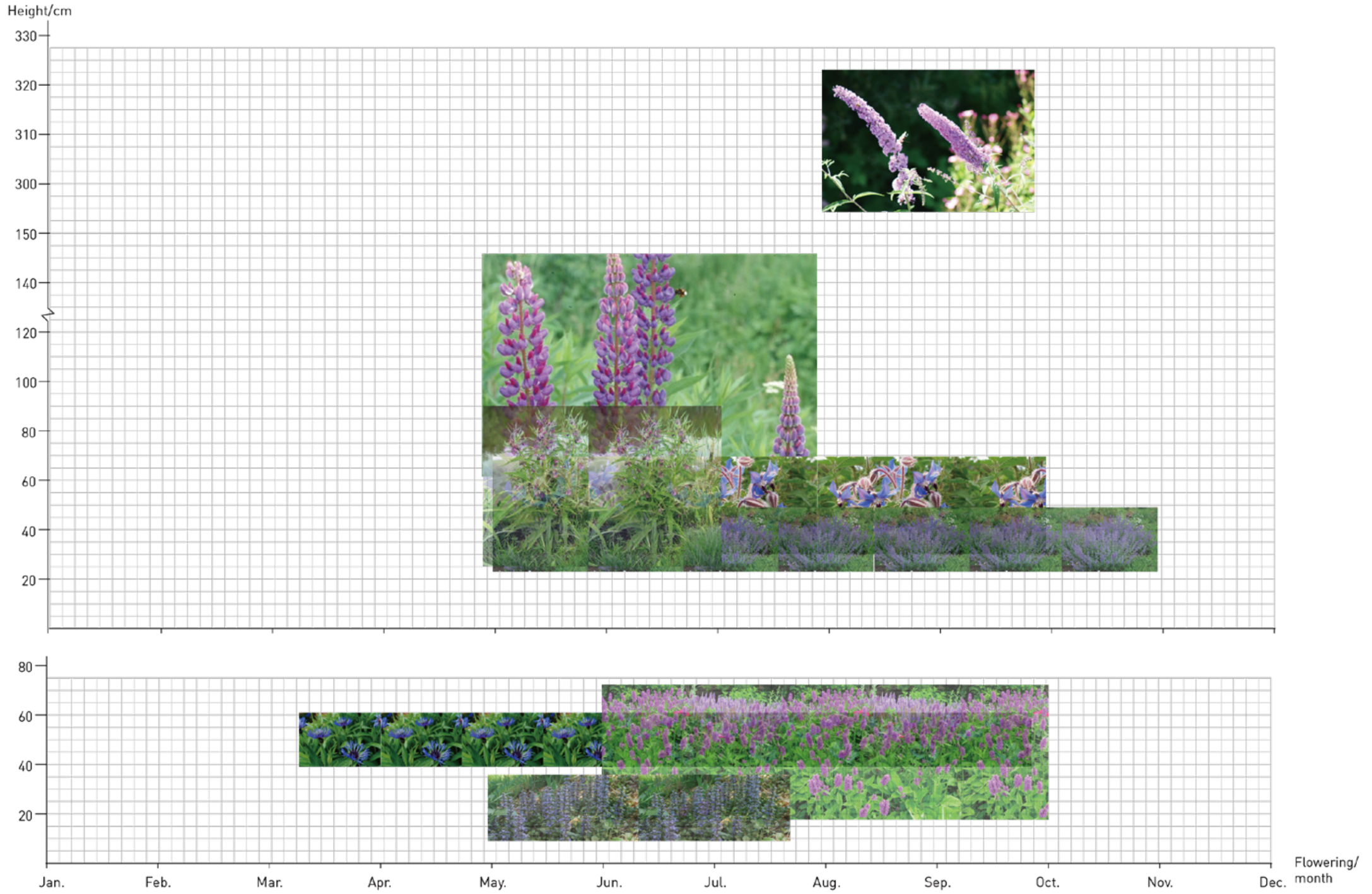
Ajuga reptans

Nepeta nepetella

Symphytum officinale

https://en.wikipedia.org/

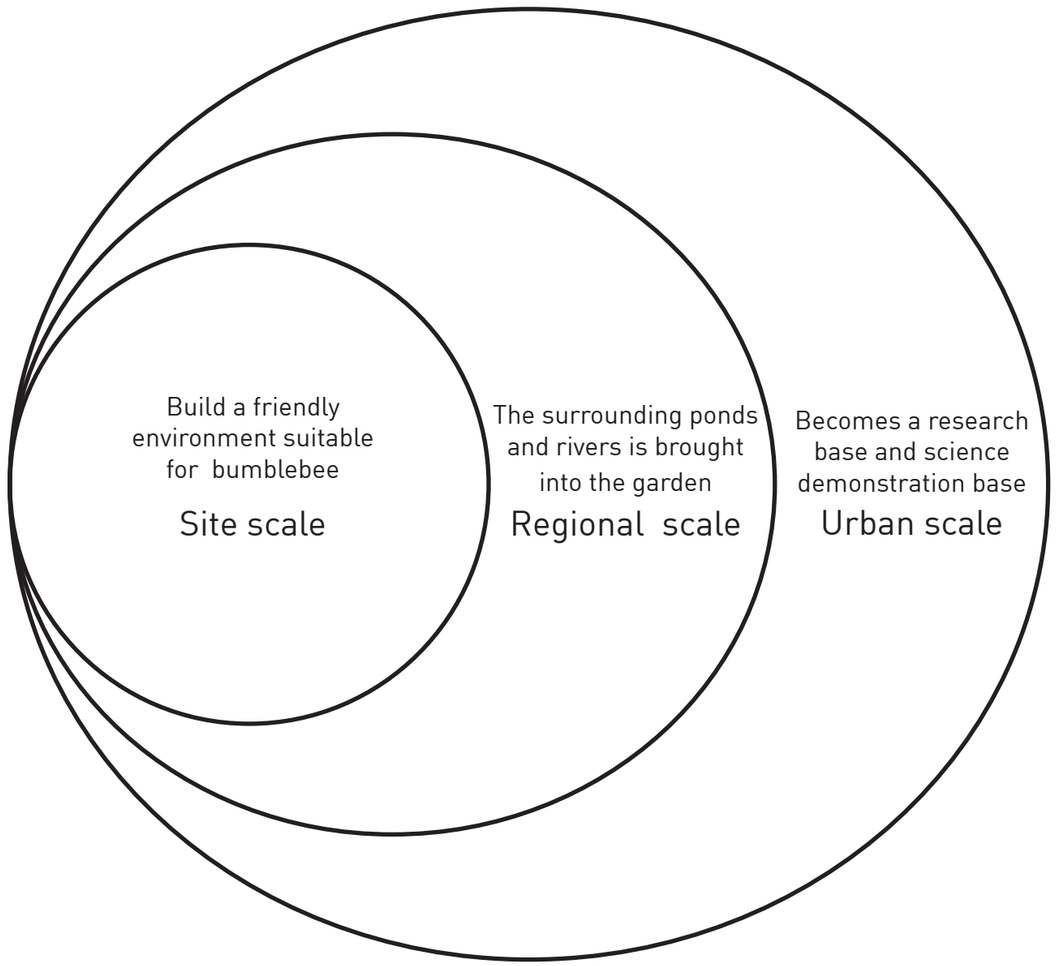
FLOWEING TIME AND PLANT HEIGHT OF FLOWERS



3.2 DESIGN

3 LEVEL

People, ecology and place



The integration of activities such as production, research and recreation into the garden restores the natural environment, promotes knowledge production, revitalizes the economy of the regional city and alleviates social anxiety, constituting a dynamic balance at the level of ecology, environment and human activity. Meanwhile, reduce the impact of human beings on the environment through design, and build a friendly and mutually beneficial relationship between human beings and the environment.

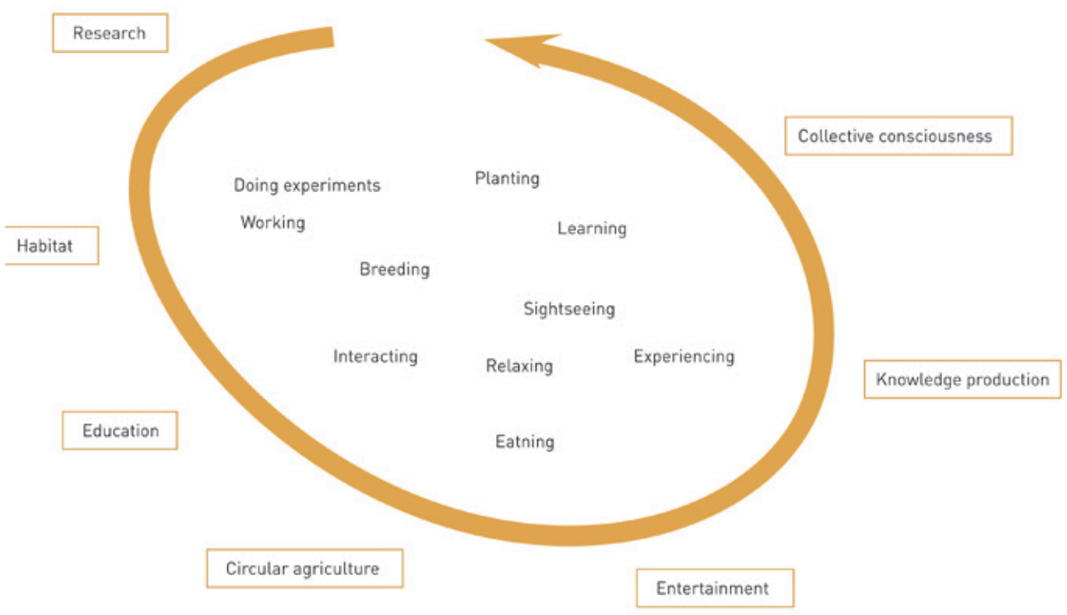
The design structures the space at three scales, establishing a friendly collaboration between people, ecology and place。
At the **site scale**, the design Regard bumblebees as the key stone species, and build a friendly environment suitable for their reproduction, feeding and activities based on the living habits of pollinators, and promote the growth of vegetables, fruits and flowers by using mixed farming methods to build synergistic interactions between pollinators and ecosystem.

At the **regional scale**, the water from the surrounding ponds and rivers is brought into the garden to supply water for irrigation facilities and hydrophilic installations, realizing efficient use of water resources by relying on the villa's unique abundance of above-ground and groundwater resources.

On an **urban scale**, the garden attracts bumblebee researchers and amateurs, and becomes a research base and science demonstration base, promoting the dissemination, popularization, application and transformation of research results. During the fruit ripening period, the garden conducts fruit picking activities to promote leisure and labor in the city, where people can also taste the harvested food and indirectly promote local people's employment.

STRATEGY

Arconati Gardens is a pollinator-friendly garden that establishes a vibrant participatory culture of crop production that transforms and revitalizes Arconati's farms. Faced with the climate crisis, land desertification, COVID-19 and other crises, Arconati farms envision a new farm model of a protected bumblebee in which eco-friendliness, site vitality, farming knowledge transfer, social equity, and energy cycle are all on display. By driving public awareness focus through the site, the city is provided with an architecture of spontaneous cycles with a source of power.



Research

Using the semi-enclosed space created by the loss of the site's roof due to fire as a greenhouse, the transparent building provides a research space for the first floor research room where seasonal crop varieties can be cultivated. The outdoor space also provides a suitable habitat for bumblebees to reveal, describe and experience the process of bumblebee-plant interactions on site. Becoming a place for biologists to collect data, observe, and experiment, the research program covers soil health, pollinator-plant architecture diversity, bio-intelligent farming methods, novel pesticides, bumblebee conservation, habitat maintenance, crop pollination, and flowering season management, promoting direct application and testing of research results and building a research-oriented economic model. The research is open to the public, and the high-tech research facilities used for the research are placed on a tour route open to the public.

Habitat

The garden is equipped with above-ground plantings to cultivate crops that benefit from bumblebee pollination and provide food such as pollen and nectar for bumblebees. Since pollen resources in late summer have an important impact on bumblebee resources in the coming year, it is important to protect bumblebees by extending the flowering period, so late flowering cover crops such as red clover and late flowering wild plant species such as ivy are planted in the plant installation in the garden. The plant installations were also combined with artificial bumblebee nests to create suitable nesting sites for them. More garden patches indicate more food for bumblebees, and thus more gardens in close proximity to each other are needed within the city to provide continuous and abundant foraging resources for bumblebees, while contributing to ecosystem restoration.

Education

The garden records the activity and growth data of bumblebees and plants, and presents them to people who come to visit in a digital way with dynamic display, inviting visitors to observe the growth cycle of plants and bumblebees, and the landscape becomes a large data carrier that becomes a projection of the future. Collaborate with schools or educational institutions to create a new outdoor education model.

Circular agriculture

People can learn about plant maintenance and experience the plant picking process, while being able to taste fresh food here. The leftover food waste from the restaurant is re-shipped back to the garden to be used as organic fertilizer. Water from the pond and river is brought into the research room and garden to provide water for irrigation.

Entertainment

The "open" space provides a sanctuary for the public, where people can meditate, listen, paint, participate in yoga, create art, learn about bumblebees and other workshops, it calms the anxious hearts of people in the city, and more public participation revitalizes the economy of the site.

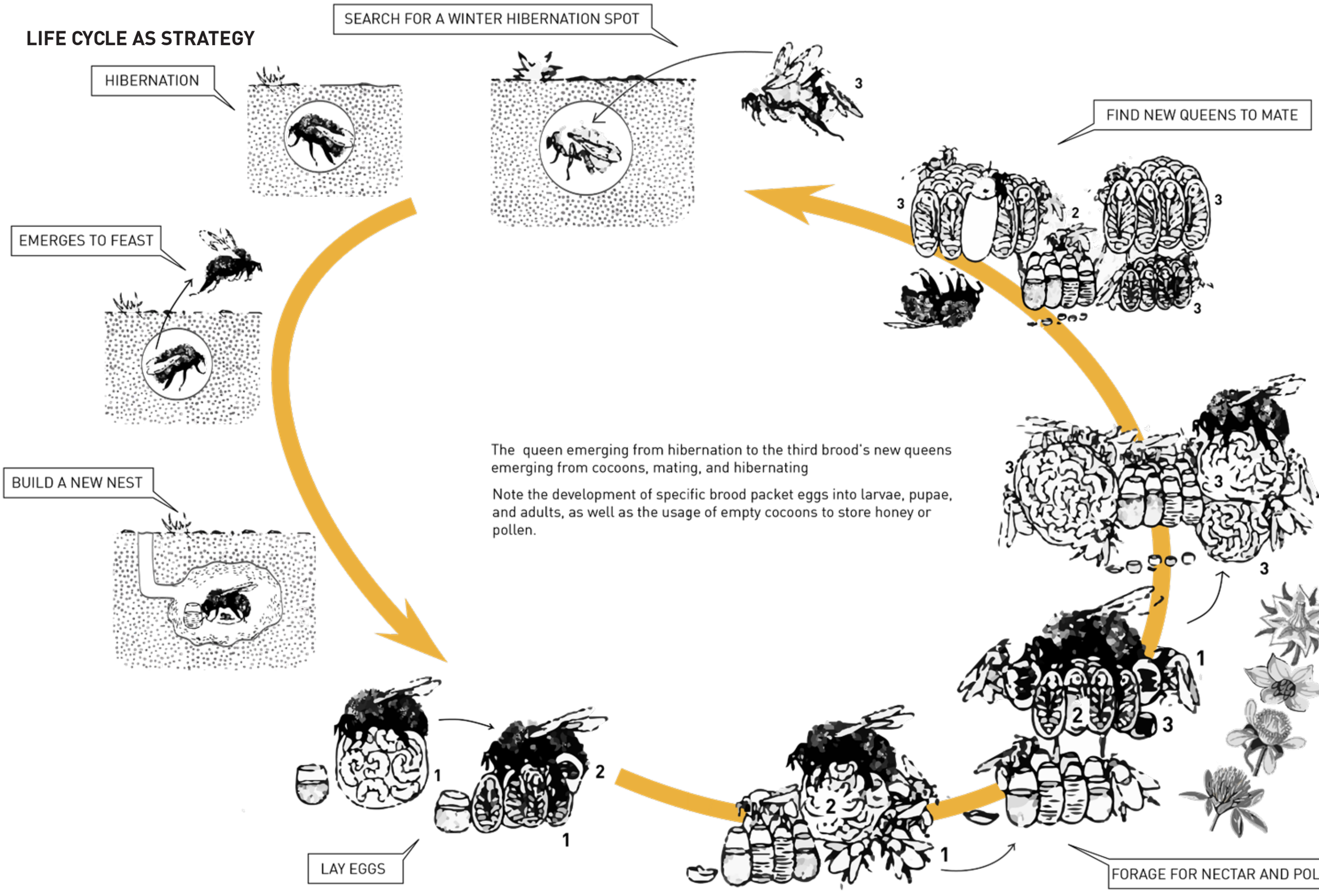
Knowledge production

Where people learn, experience and practice plant production and pass on the knowledge of land production to the next generation. In the context of the epidemic, labor becomes a high-value activity that not only relieves the anxiety of the urban population, but also encourages family-based forms of agriculture.

Collective consciousness

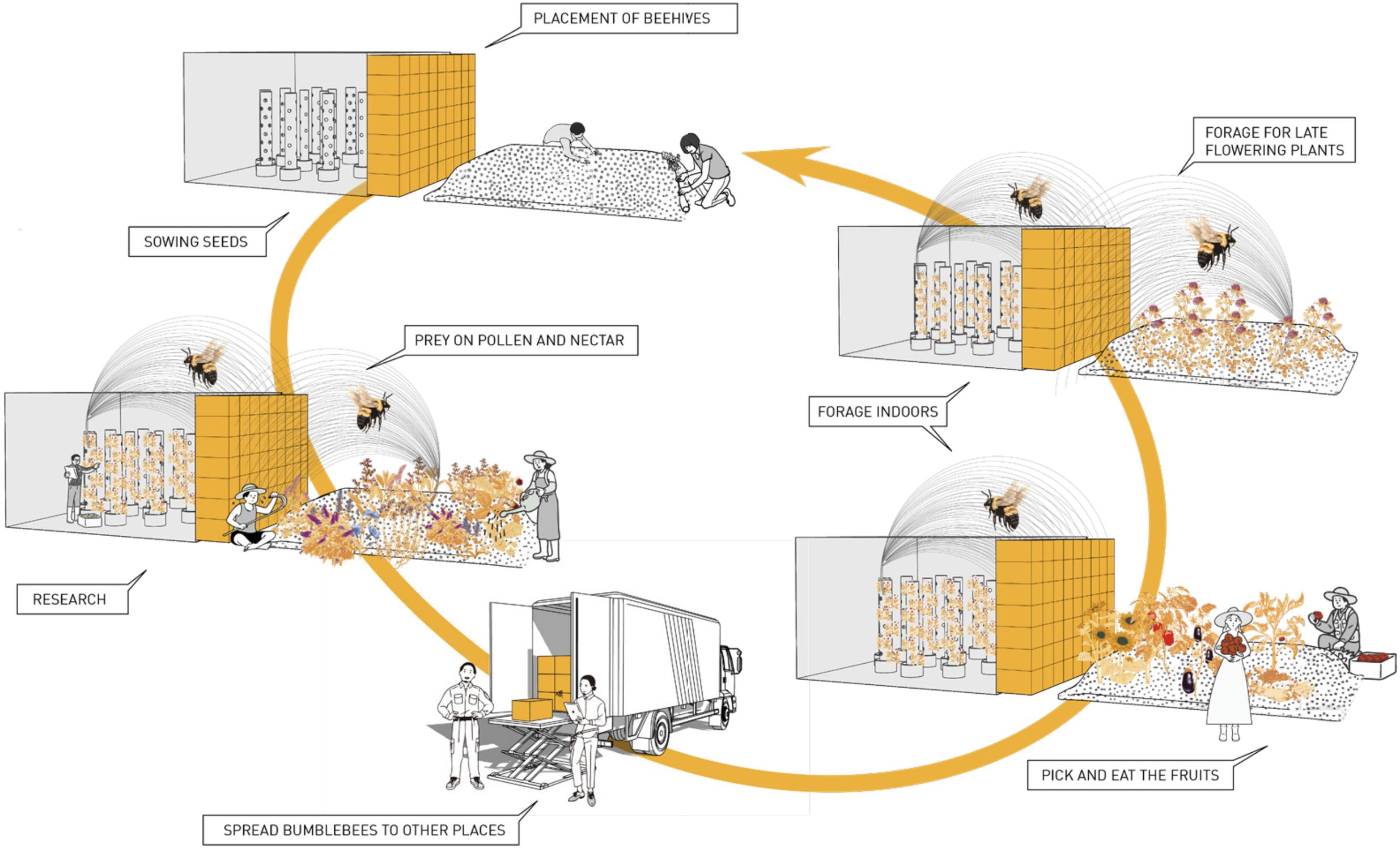
People here can be observers and scientists, evoking the true emotion of love for nature, calling for the collection of biological data around the world and the construction of a shared database of bumblebees.

LIFE CYCLE AS STRATEGY



The queen emerging from hibernation to the third brood's new queens emerging from cocoons, mating, and hibernating

Note the development of specific brood packet eggs into larvae, pupae, and adults, as well as the usage of empty cocoons to store honey or pollen.


PLACEMENT OF BEEHIVES
SOWING SEEDS
PREY ON POLLEN AND NECTAR
RESEARCH
SPREAD BUMBLEBEES TO OTHER PLACES
FORAGE FOR LATE FLOWERING PLANTS
FORAGE INDOORS
PICK AND EAT THE FRUITS

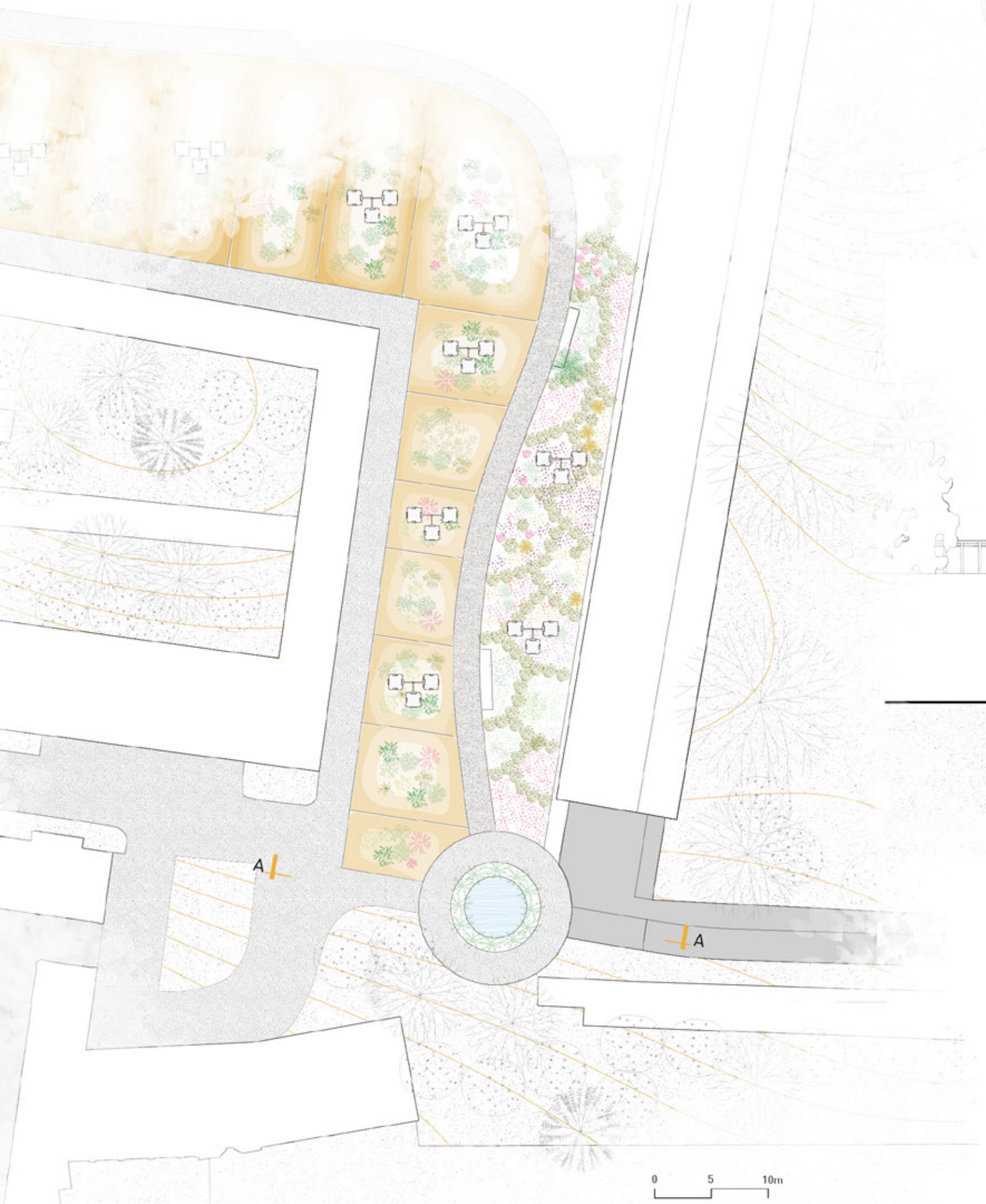
GENERAL PLAN

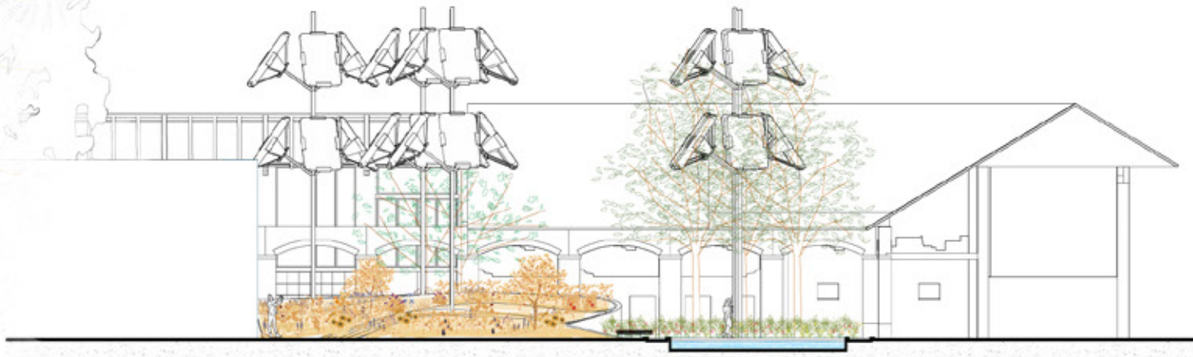
LAGHETTO DI CASTELLAZZO

VILLA ARCONATI

0 10 20m

① Calm pond
② Science Corridor
③ Crop planting and picking area
④ Four-season flower garden
⑤ Tree shade relaxation area
⑥ Nest protection
⑦ Bumblebee Institute and Workshops
⑧ Outdoor eating area
⑨ Restaurant and bar
⑩ Stone path
⑪ Water trestles





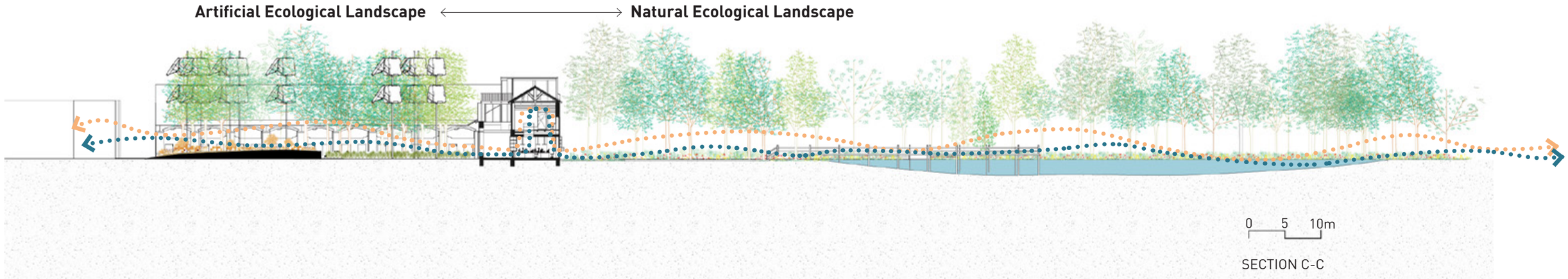
SECTION A-A


0
5
10m
B
B

SECTION

0 5 10m

SECTION B-B

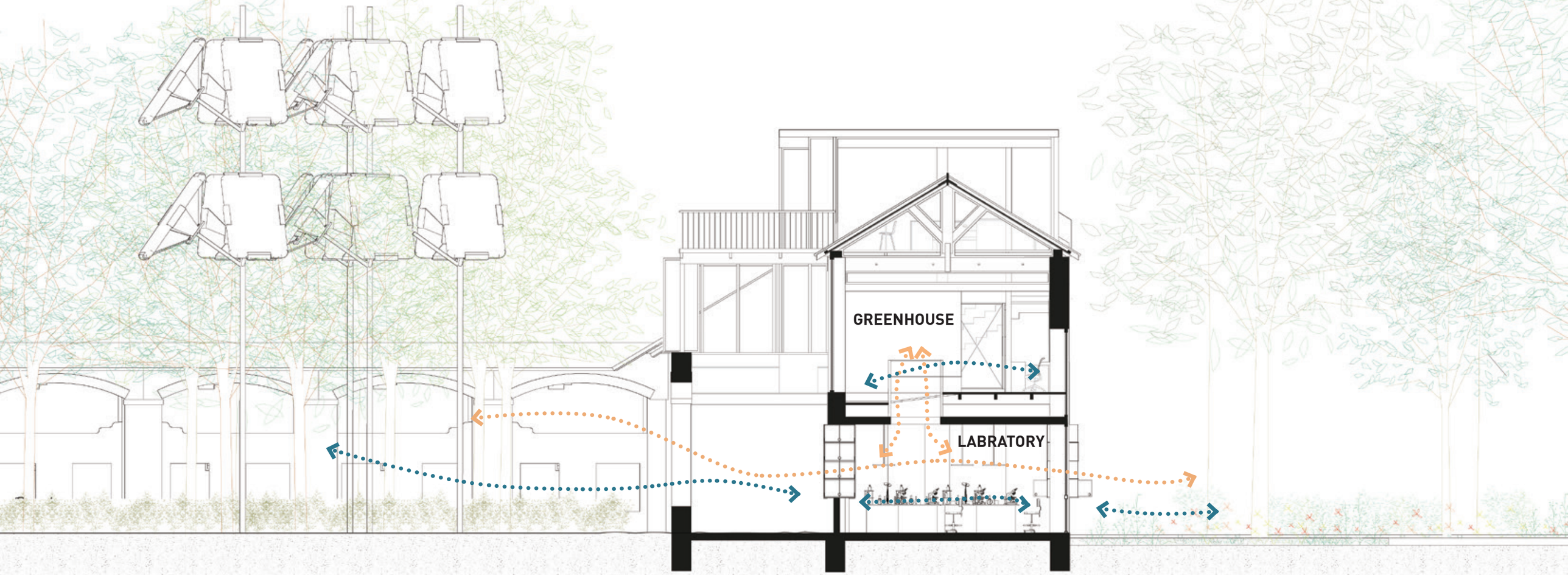


Bumblebee flow

People flow

SECTION

Bumblebee can freely travel through the indoor workshop and laboratory on the ground floor, as well as the greenhouse on the first floor and the garden outside. The space is conducive to their free flight and meets the needs of human use, and at the same time, enables the interaction between human and bear behavior.

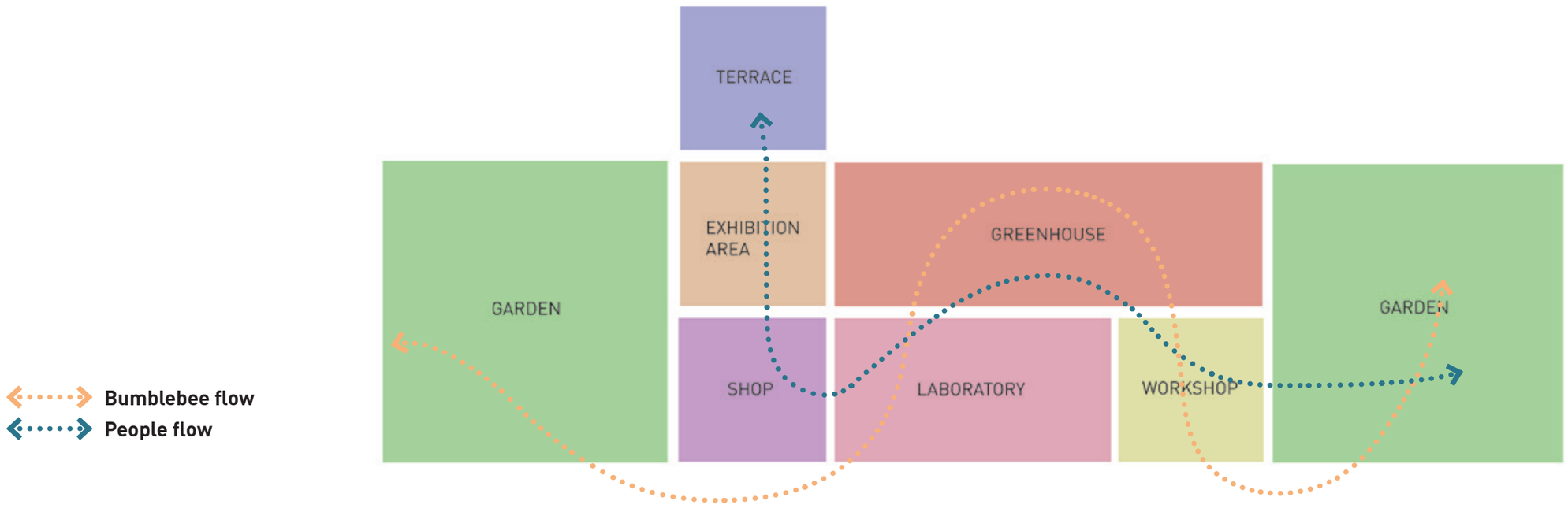


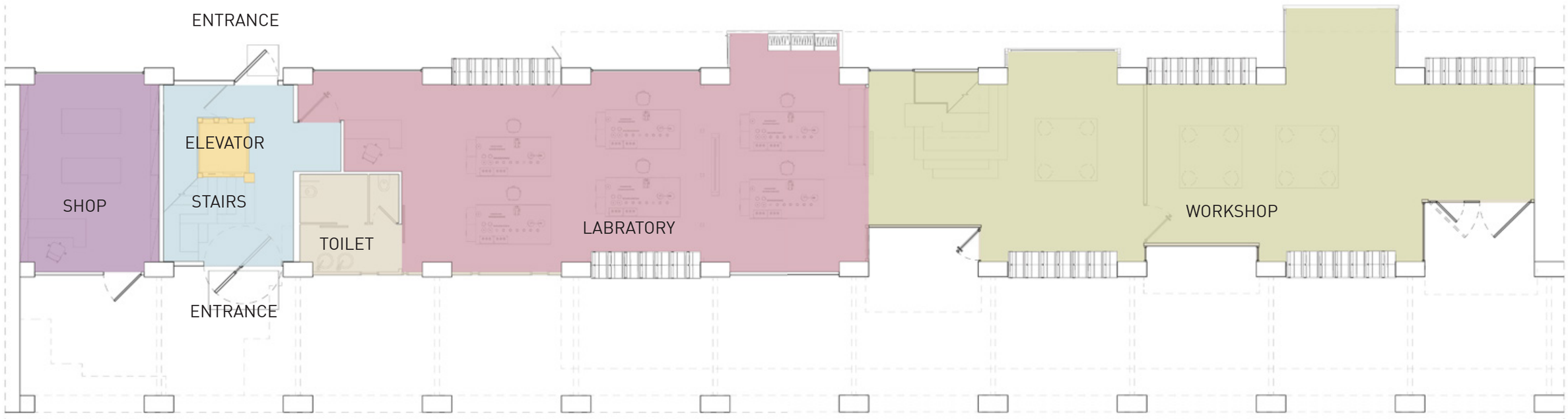
SECTION C-C SCALE:1:50

Bumblebee flow

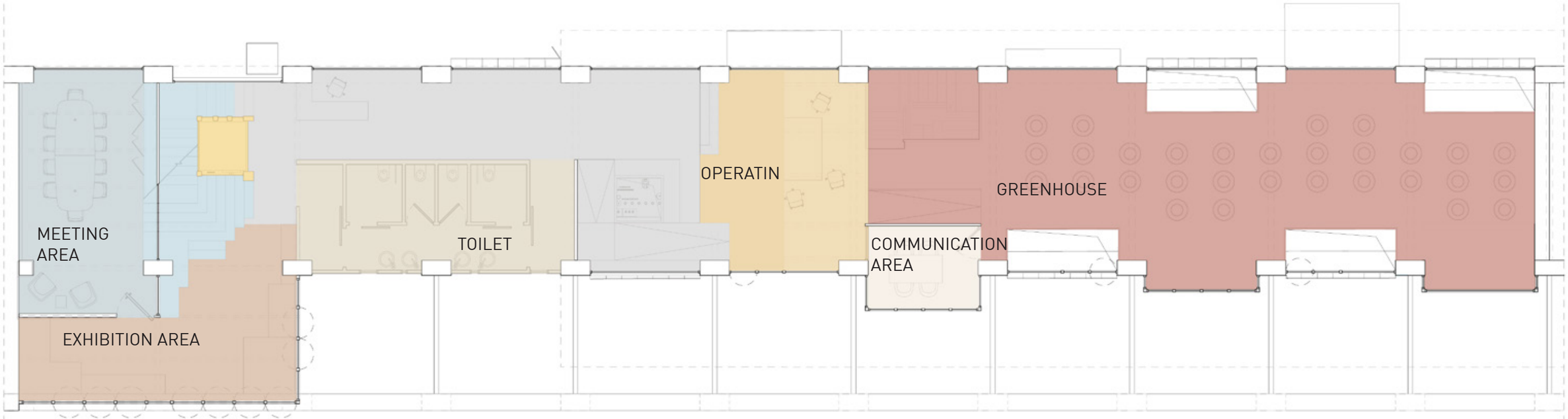
People flow

FUNCTION

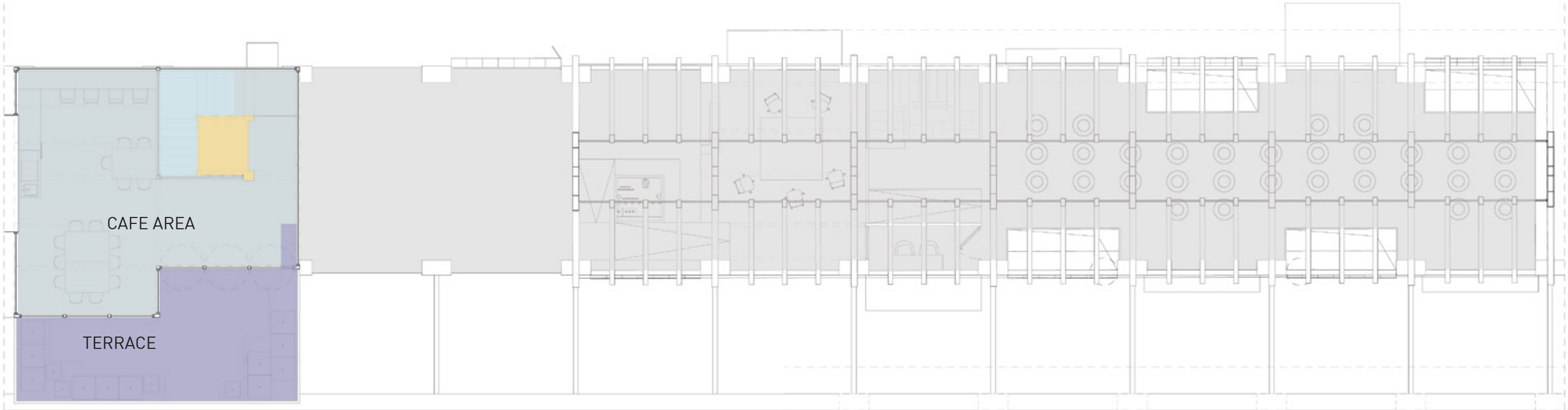




THE GROUND FLOOR



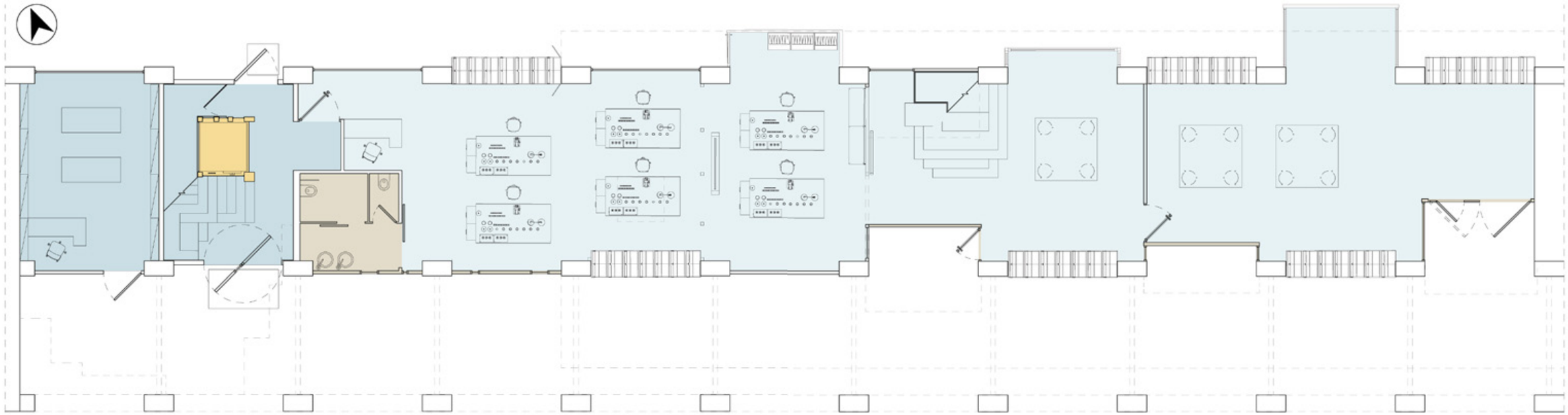
THE FIRST FLOOR



THE SECOND FLOOR

ELEVATION

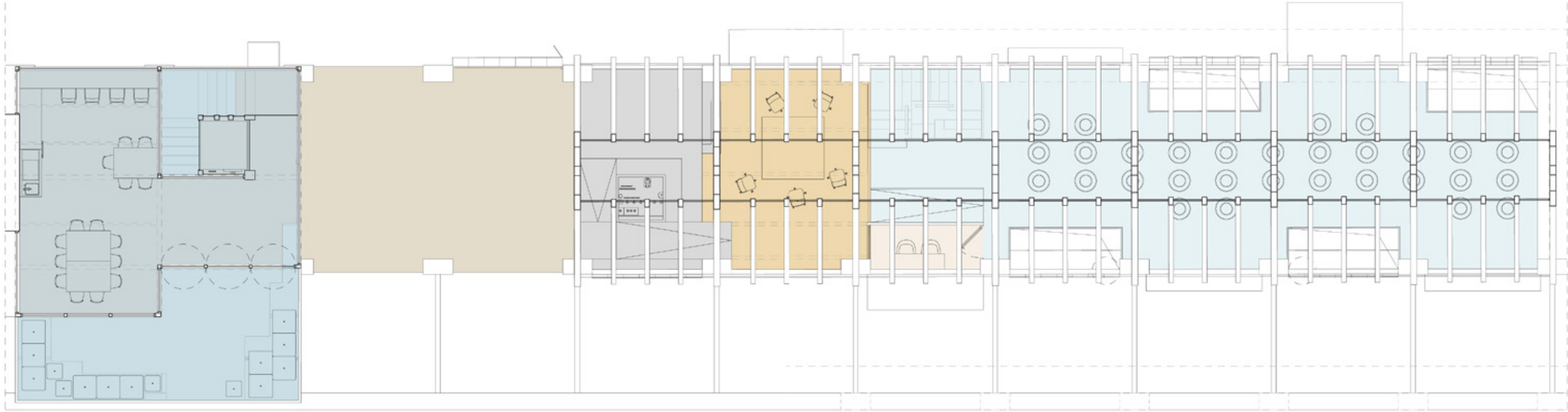
PLAN



ELEVATION

THE GROUND FLOOR
SCALE:1:100

THE FIRST FLOOR



THE SECOND FLOOR

CROP PLANTING AREA RENDERING-SPRING

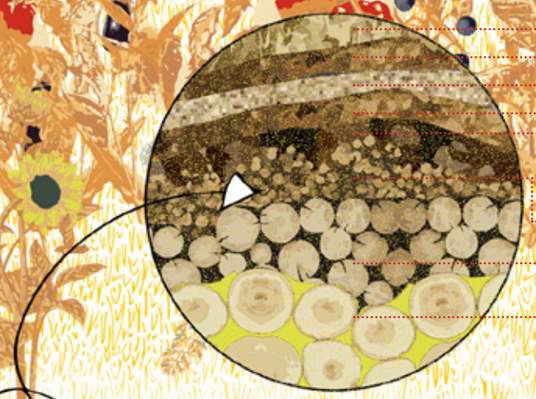
In the spring time people in the city can go to the site for weeding, planting, which not only relieves the anxiety of the urban population, but also encourages family-based forms of agriculture.People can learn, experience and practice plant production and pass on the knowledge of land production to the next generation.

SCIENCE CORRIDOR RENDERING-SUMMER

In summer, when the crops are in full flower and foliage, it is easy to observe the foraging behavior of the bear peaks. Meanwhile, the solar panels store the strong solar radiation during the day and convert it into electricity to provide lighting at night.

CROP PICKING AREA RENDERING-AUTUMN

The fruit ripens in autumn and attracts people to pick and taste it.People can learn about plant maintenance and experience the plant picking process, while being able to taste fresh food here. The leftover food waste from the restaurant is re-shipped back to the garden to be used as organic fertilizer. Water from the pond and river is brought into the research room and garden to provide water for irrigation.



GREENHOUSE RENDERING-WINTER

In winter, the greenhouse can continue to grow crops and also provide space for cultivation of new varieties of crops developed, as well as provide a suitable environment for bumblebees to promote bumblebee reproduction.

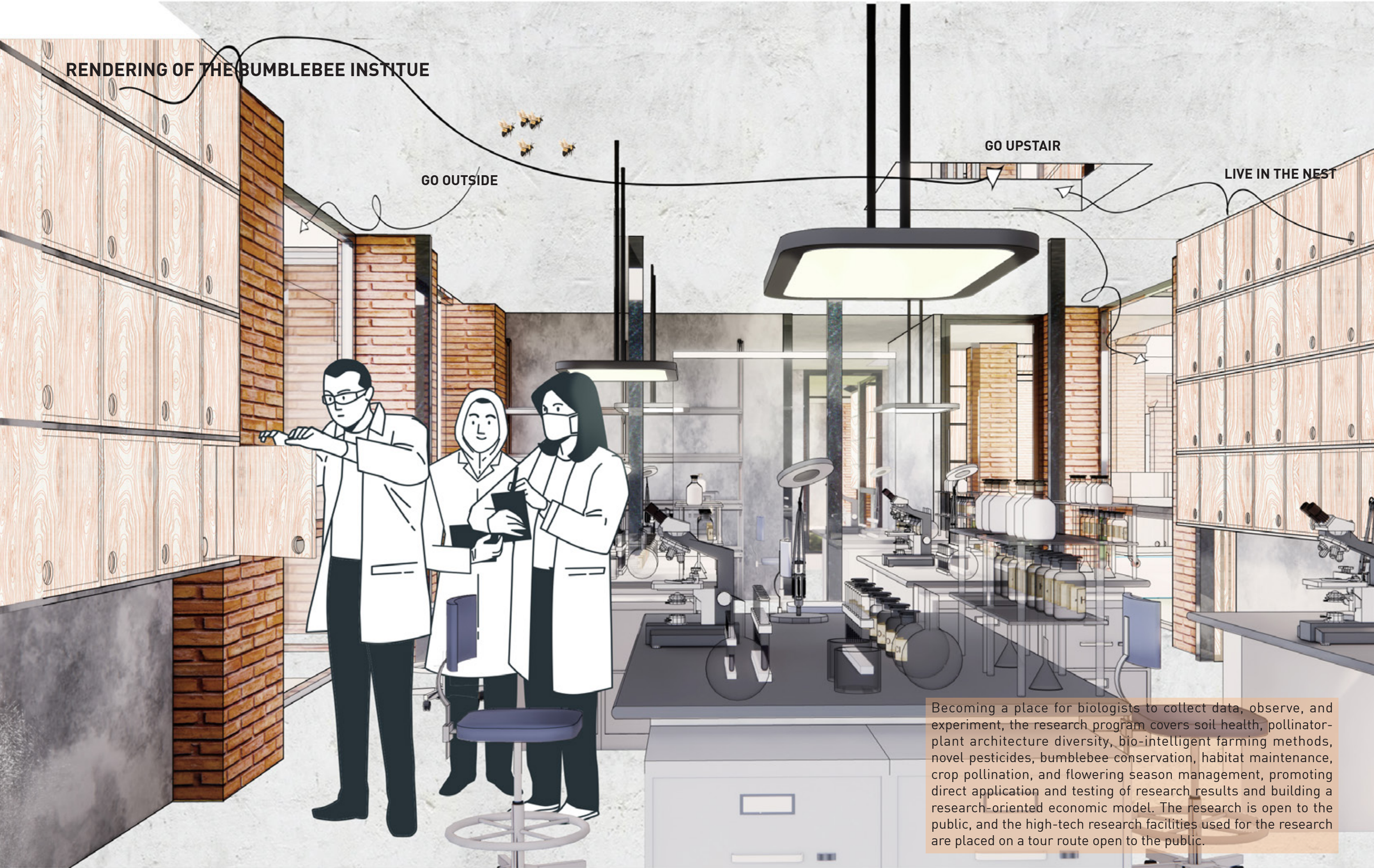
NEST PROTECTION RENDERING

Large numbers of bumblebees can be transported to other spaces in the city to provide pollination services that

RED CLOVER

TRANSPORT

RECORD DATA



Becoming a place for biologists to collect data, observe, and experiment, the research program covers soil health, pollinator-plant architecture diversity, bio-intelligent farming methods, novel pesticides, bumblebee conservation, habitat maintenance, crop pollination, and flowering season management, promoting direct application and testing of research results and building a research-oriented economic model. The research is open to the public, and the high-tech research facilities used for the research are placed on a tour route open to the public.

MATERIAL BOARD

Conclusion

Design focus on the nonmaterial interdependent in Villa Arconati, creating the pollinator-friendly garden, Based on the analysis of the current problems and opportunity of the site, the design proposes the strategy of the bumblebee life cycle to intervene habitat restoration in foraging habitat, nesting habitat and stepping stone habitat. Furthermore, the implantation of the research organization, education activity, circular agriculture system, entertainment activity, habitat restoration, etc, energizes the site from the site scale, regional scale, and the urban scale.

Space is the carrier of human activity, which is based on the natural ecosystem, the birthplace of the rich culture in specific contexts. Designers as leaders in the space regeneration field, can not ignore the importance of biodiversity and challenge the dominant design paradigm of people-oriented, relying on the expertise of biologists to conduct biodiversity assessments and address elements of biodiversity planning. Integrating ecological thinking into the design process is no longer an option or an alternative; it is necessary. A harmonious relationship between all life forms needs to be created, which can promote the sustainable development of our planet.